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AN 16-35TS148-5

Handbook

Operation and Maintenance Instructions

AN/UPM-33 TS-148/UP

TEST EQUIPMENT SPECTRUM ANALYZER

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND THE CHIEF OF THE BUREAU OF AERONAUTICS

(Mfg.: Navy)

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UNSATISFACTORY REPORT

FOR U. S. ARMY AIR FORCE PERSONNEL

In the event of malfunctioning, unsatisfactory design or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an unsatisfactory report, AAF Form No. 54 or a report in similar form shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54, listing:

1. Station and organization.
2. Nameplate data (type number or complete nomenclature if nameplate is not attached to the equipment).
3. Date and nature of failure.
4. Radio model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

FOR U. S. NAVY PERSONNEL

Report of failure of any part of this equipment during its guaranteed life shall be made on Form NAVAER-4112 "Report of Unsatisfactory or Defective Material," or a report in similar form, and forwarded in accordance with the latest instructions of the Bureau of Aeronautics. Such reports of failure shall include:

1. Reporting Activity.
2. Nameplate data.
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Remedy used or proposed to prevent recurrence.

FOR U. S. NAVY SHIP-SHORE PERSONNEL

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures, see Chapter 67 of the "Bureau of Ships Manual," or superseding instructions.

ORDERING PARTS—All requests or requisitions for replacement material should include the following data:

1. Navy stock number or, when ordering from an Army supply depot, the Army stock number.
2. Name of part.

If the Navy stock number has not been assigned, the requisitions should specify the following:

1. Equipment model designation.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. AWS, JAN, or Navy type designation.

DESTRUCTION OF ABANDONED MATERIEL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment and when ordered to do so by proper authorities, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:—

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy objects are readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:—

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instrument boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil and watercooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

WARNING!

DO NOT OPERATE THE EQUIPMENT IF THE SUPPLY VOLTAGE CANNOT BE KEPT BETWEEN 105 AND 125 VOLTS. IF THE VOLTAGE APPROACHES 105 OR 125 VOLTS, BE READY TO TURN EQUIPMENT OFF. OPERATING THE EQUIPMENT ON VOLTAGES BELOW 105 OR ABOVE 125 VOLTS MAY DAMAGE CIRCUITS AND TUBES AND RENDER THE EQUIPMENT INOPERATIVE.

SAFETY NOTICE

WARNING - 2000 VOLTS

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES THAT ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE THE EQUIPMENT WITH THE HIGH VOLTAGE SUPPLY ON. VOLTAGES UP TO 2000 VOLTS ARE PRESENT ON MANY POINTS INSIDE THE EQUIPMENT. DO NOT DEPEND UPON SWITCHES FOR PROTECTION BUT ALWAYS SHUT DOWN MAIN POWER SUPPLY, OR PULL OUT POWER CABLE FROM SUPPLY LINE CONNECTOR. DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER OFF, BECAUSE OF CHARGES RETAINED BY CAPACITORS. TO AVOID CASUALTIES ALWAYS DISCHARGE AND GROUND CIRCUITS BEFORE TOUCHING THEM.

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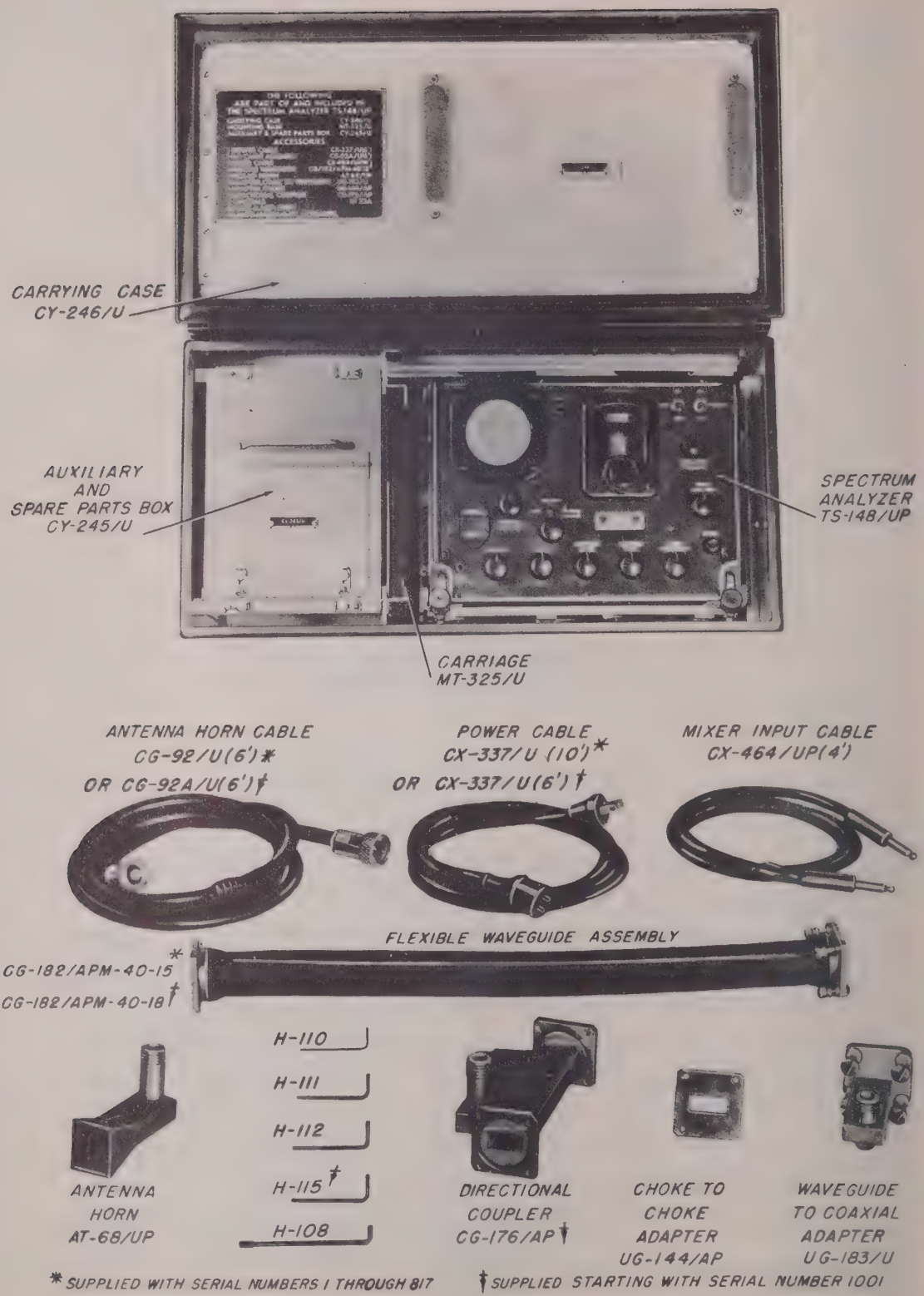


Figure 1-1. Spectrum Analyzer, Cables and Auxiliary Parts

SECTION I

GENERAL DESCRIPTION

1. GENERAL INFORMATION.

a. The Spectrum Analyzer TS-148/UP is test equipment designed for use with radar and beacon equipment operating within the frequency range of 8470 to 9630 megacycles per second.

b. The Spectrum Analyzer TS-148/UP provides a visual indication of the spectra of radio frequency oscillators within its range. It incorporates a frequency meter which permits it to be used as a frequency measuring device. The spectrum analyzer may also be used to measure the frequencies of resonant cavities, echo boxes, magnetrons, and local oscillators, if their frequency lies within the range of the analyzer.

c. The instructions in this handbook describe the procedures for the installation, operation, adjustment, and maintenance of the equipment. A section is included that describes the theory of operation of the analyzer, for the information and guidance of personnel using the equipment.

TABLE I

Qty. per Equip.	Name of Unit	Army-Navy Type Designation	Overall Dimensions	Weight Pounds	Reference Symbol Numbers
1	Spectrum Analyzer	TS-148/UP	25″x13″x19¼″	39	100-199
1	Wave-guide to Coaxial Adapter	UG-183/U	2½″x1″x1½″	0.4	E-202
1	Antenna Horn	AT-68/UP	1 3/64″x3 21/64″x2 13/64″	0.25	E-201
1	*Antenna Horn Cable	CG-92/U(6′)	6′ 1″ Length	1	W-203
		or			
1	†Antenna Horn Cable	CG-92A/U(6′)	6′ 1″ Length	1	W-203
1	Mixer Cable	CX-464/UP(4′)	4′ 3″ Length	0.25	W-202
1	*Power Cable	CX-337/U(10′)	10′ Length	0.5	W-201
		or			
1	†Power Cable	CX-337/U(6′)	6′ Length	0.4	W-201
1	*Flexible Wave-guide Assembly	CG-182/APM-40-15″	1⅛″x21/32″x15″	0.25	E-203
		or			
1	†Flexible Wave-guide Assembly	CG-182/APM-40-18″	1⅛″x21/32″x18″	0.32	E-203
1	†Directional Coupler	CG-176/AP	5″x2¼″x2 7/16″	0.75	Z-101
1	Auxiliary and Spare Parts Box	CY-245/U	16⅜″x7¼″x10 1/16″	6	—
1	Carriage, Shock Absorbing	MT-325/U	16 11/32″x13¾″x11 11/16″	49	—
1	Carrying Case	CY-246/U	25″ x 19″ x13½″		
1	Choke-to-Choke Adapter	UG-144/AP	1⅝″x1⅝″x0.062″	0.06	E-204
1	†Allen Wrench for #10 Set Screw			—	H-115
1	Allen Wrench for #8 Set Screw			—	H-112
1	Allen Wrench for #6 Set Screw			—	H-111
1	Allen Wrench for #4 Set Screw			—	H-110
1	Tuning Wrench			—	H-108
2	Crystals	1N23A			
6	Fuses—2 amp.—250 V.				
4	Lamps—Mazda 6-8 V. 0.25 amps.				

* Supplied with equipments Serial numbers 1-817.
† Supplied starting with equipment Serial number 1001.

d. This handbook describes several modifications of Spectrum Analyzer TS-148/UP. The TS-148/UP equipment has been manufactured under several different contracts is shown in Table II.

TABLE II

Contract	*Serial Numbers*
NXsa-59108	1-817
N383s-1427	1001-1688
N383s-45628	10,000-10,556
N383s-46737	10,557-10,563
N383s-59577	higher than 10,563
N383s-61061	higher than 10,563

In using this handbook, therefore, reference to the various illustrations should be made by serial number.

Note

All information in this handbook applying to serial numbers 1001 through 1688 applies to serial numbers 10,000 and higher also, unless otherwise noted.

e. The information in this handbook does not alter or supersede any previous instructions issued to the Armed Forces.

2. EQUIPMENT SUPPLIED.

The complete Spectrum Analyzer TS-148/UP equipment supplied is shown in Figure 1-1 and listed in Table I, including accessories, tools, test-cable assemblies, and running spares, together with the weights and dimensions of the various items. Corresponding components of individual equipments are completely interchangeable, even though specific dimensions may vary. (See also Section VI of this handbook, the complete Table of Replaceable Parts.)

3. EQUIPMENT NOT SUPPLIED.

The Directional Coupler CG-176/AP, listed in Table I, was not supplied in the first procurement, Contract NXsa-59108. Those Spectrum Analyzers TS-148/UP which were not supplied with the Directional Coupler require it only when extremely stable coupling is necessary.

4. PHYSICAL DESCRIPTION.

a. SPECTRUM ANALYZER.

(1) The Test Equipment TS-148/UP is illustrated in Fig. 1-1. The Spectrum Analyzer is a self-contained unit, built into a sheet aluminum housing. Two handles are provided on the control panel to facilitate its removal from the Carrying Case. The electrical components are built on an aluminum chassis located inside the removable dust cover. The Analyzer is transported with the Auxiliary and Spare Parts Box in a Carrying Case. It is secured in the Carrying Case with two thumb-screws. The bezel on the cathode-ray tube is equipped with supporting pins upon which a light shield from an AN/APS-6 equipment may be mounted.

b. ASSOCIATED EQUIPMENT.

(1) The Carrying Case is made of sheet aluminum and is finished with grey paint. The lid has a piano-type hinge and is secured with two trunk fasteners. The Carrying Case is shown in Fig. 1-1. It is arranged so that the Analyzer may be operated without removing it from the Carrying Case if the Auxiliary and Spare Parts Box has been removed.

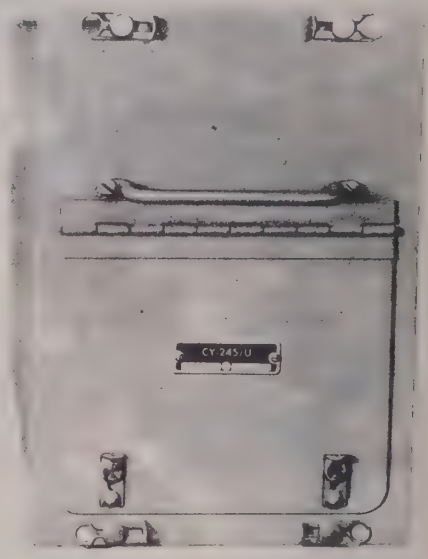


Figure 1-2. Spectrum Analyzer, Auxiliary and Spare Parts Box CY-245/U

(2) The Carriage is used to provide a shock-mounting for the Analyzer, in or out of the Carrying Case. It is fabricated from light gauge channeled aluminum with rubber cushions placed between the Analyzer and the Carrying Case. These cushions are secured to the Carriage frame. The Carriage can be removed from the Carrying Case if it is necessary to provide a shock-mounting for the Spectrum Analyzer when it is used outside of the Carrying Case. The cushions must be removed from the Carriage in order to free it from the Carrying Case. They are replaced after the Carriage has been removed.

(3) The Auxiliary and Spare Parts Box is illustrated in Fig. 1-2. This box is packed in the Carrying Case beside the Analyzer. It is held in place with four snap fasteners. The front panel has a handle to facilitate its removal from the Carrying Case. The box is made of sheet aluminum and is provided with two access doors.

One door is located on the front below the carrying handle. The other door is located on top of the box.

5. ELECTRICAL DESCRIPTION.

a. Test Equipment TS-148/UP is a self-contained portable spectrum analyzer. It is a very sensitive microwave receiver whose output is displayed on a cathode-ray tube. The Analyzer has a frequency meter which is calibrated to read directly in megacycles, a frequency-swept r-f oscillator, a crystal mixer and associated plumbing, narrow band i-f amplifiers, an oscilloscope tube, and the necessary power supplies.

b. The Spectrum Analyzer resolves an r-f signal into its frequency components and displays the results on an oscilloscope screen so as to show amplitude plotted against frequency. The relative position of each pip (which represents a frequency component), with respect to the sweep, indicates its frequency. The

height of the pip represents its contribution in power to the total power of the r-f signal under test.

6. APPLICATION.

a. GENERAL.

(1) The Spectrum Analyzer is easy to use because it is so sensitive that the magnetron signal can usually be picked up at some distance from the source, without the use of connecting cables. This feature permits observations to be made on the bench, in the plane, on the carrier deck, hangar apron, or wherever necessary.

b. SPECTRUM ANALYZER AS A FREQUENCY METER.

(1) Spectrum Analyzer TS-148/UP can be used to visually examine the spectra of magnetrons, local oscillators, test sets, and other equipment operating within its frequency range. The frequency meter in the Spectrum Analyzer may be used to measure accurately the frequencies of any of the above, or to set the frequency of radar and beacon local oscillators in radar sets.

c. FREQUENCY-MODULATED OSCILLATOR.

(1) The Spectrum Analyzer can also be used as a frequency modulated oscillator to tune T/R Boxes and R/T (antiT/R) Boxes in transmitter-converters. It can be used to check magnetron pulling and AFC circuits. If the resonant frequency of any component (such as an echo box) lies within the frequency range of the Analyzer, it can be easily and accurately checked.

7. GENERAL CHARACTERISTICS.

a. The general operating characteristics of the Spectrum Anaylzer are listed in Table II.

8. EQUIPMENT TUBE COMPLEMENT.

All vacuum tubes used in the equipment are listed by tube types in Table III, including four neon voltage regulator bulbs. For the function and circuit designation of the various tubes refer to Page 5-1.

TABLE II

Power Supply	50-1200 Cps; 105-125 Volts; 125 Watts
Tuning Range	Limited by local oscillator. The range varies with different Type 2K25 tubes.
Frequency-meter Range	Calibrated directly from 8470 mc/s to 9630 mc/s.
Sweep Frequencies	Continuously Variable from 10 to 30 Cps.
Attenuation (Spectrum Amplitude)	Uncalibrated. Variable from 3 to 70 db.
Operating Temperature Range	−40°C. to +55°C.
Frequency swing of analyzer r-f oscillator (sawtooth FM)	40 to 50 mc/s.
Overall i-f bandwidth at half power points	50 kc/s.
Sensitivity to CW—Spectrum Amplified Pos.—80 db. below 1 watt for 1 inch of deflection on Oscilloscope Screen —Spectrum Position—55 db. below 1 watt for 1 inch of deflection of Oscilloscope Screen.	
Indicator	Cathode ray tube.
Maximum dispersion of spectra	1.5 mc/s per inch.
Power output	Approximately 1 milliwatt.
Tube Complement	See Page 5-1

TABLE III

Quantity	Type Designation	Tube Type
1	2K25	Klystron, Integral Cavity
1	2X2	High Voltage Vacuum Rectifier
1	3BP1	Electrostatic Deflection and Focus Cathode Ray Tube
1	5R4GY	Full Wave High Vacuum Rectifier, Receiving
1	6AC7	Sharp Cutoff R-F Pentode
1	6SA7	Pentagrid Converter
3	6SJ7	R-F Pentode, Sharp Cut Off
3	6SN7-GT	Twin Triode
1	6Y6	Beam Power-Amplifier
1	884	Sweep Oscillator
4	991	Voltage Regulator

SECTION II
OPERATION AND ADJUSTMENT

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. PERSONNEL MUST OBSERVE ALL SAFETY REGULATIONS AT ALL TIMES.

1. INSTALLATION.

a. The Spectrum Analyzer should be removed from its carriage and carefully inspected for broken or damaged parts before any attempt is made to put it into operation. As stated in Section I, Par. 4, the Analyzer may be used in or out of the Carrying Case. If it is to be used in the Carrying Case, remove the Auxiliary and Spare Parts Box. Open the door that allows access to the r-f plumbing, and the a-c power receptacle. This door is shown in Fig. 2-1. Insert the connector on the power cord into the power socket. Then insert the power cord plug into a 105-125 volt, 50-1200 cps a-c source.

b. The carriage can be removed from the Carrying Case if shock-mounting is desired when the equipment is to be used outside the Carrying Case.

c. The flexible wave guide is fastened to the Type UG-40/U Choke flange on the plumbing of the Analyzer by means of four captive screws in the flange of the wave guide. The Antenna Horn is connected to the Analyzer through the coaxial cable and the coaxial cable-to-wave guide adapter. See Fig. 5-4. Four captive screws in the flange of the Adapter are used to secure it to the plumbing. Other methods of coupling are shown in Figs. 5-5 and 5-6.

Figure 2-1. Spectrum Analyzer, Control Panel

2. PRE-OPERATION CHECK.

a. GENERAL.

(1) The test in Par. 2*c* of this section may be performed by personnel in charge of test equipment before the Analyzer is issued for use. The user may omit this test if there is definite assurance that it has been made.

b. TURNING THE ANALYZER ON.

(1) Turn the POWER switch S-101 to its ON position. The locations of this switch and the other operating controls are shown in Figs. 2-1, 2-2 and 2-3. The analyzer r-f oscillator tube should heat up and operate normally in approximately one minute.

c. SWEEP AND INDICATOR CIRCUITS, ANALYZER R-F OSCILLATOR.

(1) Turn the MIXER AMPLIFIER control R-127 counterclockwise to zero.

(2) Adjust the INTENSITY control R-163 until the desired brilliancy is obtained.

(3) Place the SELECTOR switch S-103 in the MIXER position. A horizontal trace should appear on the screen about one inch from the bottom of the tube.

(4) Turn the MIXER AMPLIFIER R-127 and SPECTRUM WIDTH R-153 controls as far as they will go in a clockwise direction.

(5) Adjust the SPECTRUM CENTER control R-167 until a symmetrical bell-shaped hump appears on the screen of the scope. See Fig. 2-4. This control adjusts the d-c reflector voltage in the analyzer r-f oscillator. Two different humps may be obtained at two different settings of the SPECTRUM CENTER control. Either hump is satisfactory.

(6) Adjust the MIXER AMPLIFIER control until the pattern on the screen is approximately two inches high.

Note

The controls described in steps (7) to (11) have been accurately set at the factory and it should not be necessary to make these adjustments unless the cathode-ray tube has been replaced.

(7) If the vertical position of the trace is too high or too low, locate it properly with the screwdriver control R-133 marked VERTICAL-MIXER when the SELECTOR switch is in the MIXER position. If the SELECTOR switch is in either the SPECTRUM or SPECTRUM AMPLIFIED positions, adjust the trace with the control R-117 marked VERTICAL-SPECTRUM. Note that two controls are necessary to accomplish vertical centering for all switch positions. These controls are shown in Fig. 2-2.

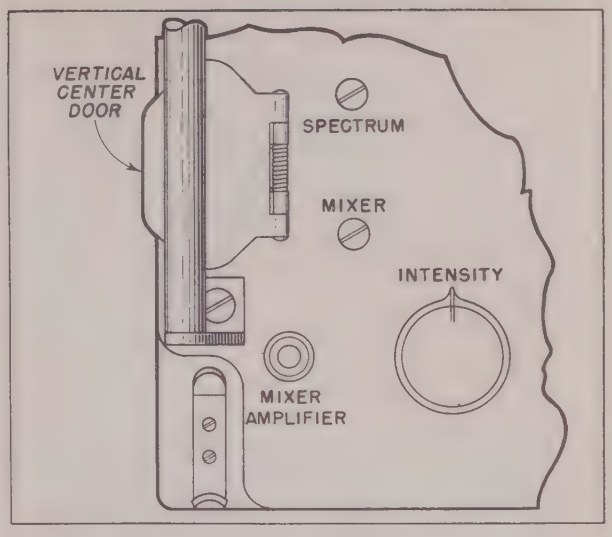


Figure 2-2. Vertical Centering Controls

(8) If the horizontal position of the pattern is not centered properly, remove the dust cover, insert a screwdriver in the control R-144 marked HORIZONTAL CENTERING and adjust it until the pattern is centered correctly. This control is directly in front of V-112 in Fig. 2-3. The dust cover slides off when the screw fasteners have been loosened.

(9) If the trace is too long or too short, turn the HORIZONTAL AMPLITUDE control R-140 until the length of the trace is slightly less than the width of the screen. This control is directly in front of V-108 as shown in Fig. 2-3.

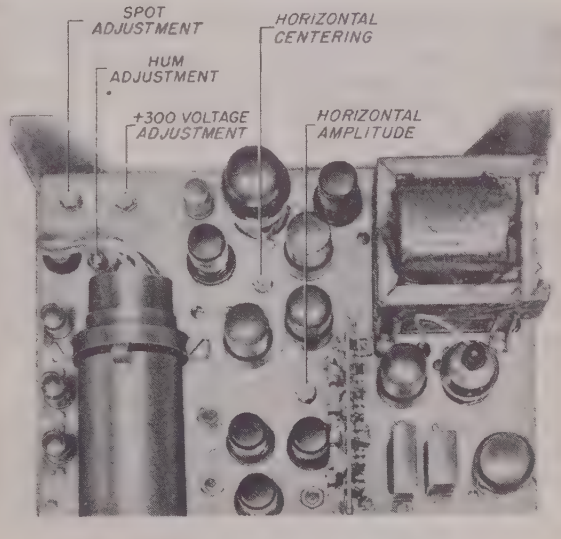


Figure 2-3. Spectrum Anaylzer, Dust Cover Removed to Show Chassis Controls

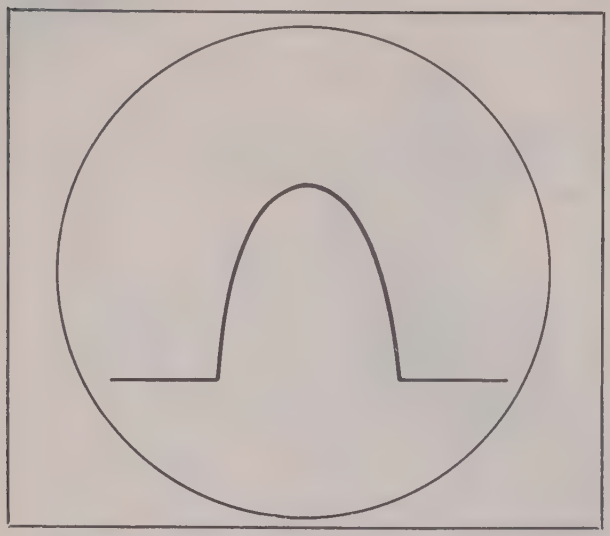


Figure 2-4. Analyzer R-F Oscillator Pattern

(10) If the hum level appears to be too high turn the control R-193 labeled HUM ADJUSTMENT with a screwdriver until the hum is reduced to a minimum. See Fig. 2-3 for the location of this control.

(11) If the pattern on the screen is out of focus, even when the trace itself is sharply focused, turn the SPOT ADJUSTMENT control R-174 for the best appearance of the pattern and readjust the FOCUS control R-165 to refocus the trace. Repeat these operations alternately until the desired focus is obtained. It may be necessary to turn the SPECTRUM WIDTH control R-153 counterclockwise until enough of the trace appears to allow it to be focused. This control is located next to the +300 VOLTAGE ADJUSTMENT control R-182 in the left rear corner of the chassis as shown in Fig. 2-3.

(12) Adjust the SPECTRUM WIDTH control R-153 until the pattern covers the full width of the screen as shown in Fig. 2-4. The appearance of this pattern, centrally located and spread over the full width of the screen, shows whether or not the analyzer r-f oscillator is operating properly.

(13) Check the frequency sweep of the analyzer r-f oscillator by turning the FREQUENCY control E-101A until the frequency meter pip appears on the screen as shown in Fig. 2-5. Observe the dial reading when the pip coincides with the extreme left side of the pattern. Shift the pip to the right side and observe the dial reading again. The difference in dial readings represent the frequency sweep of the analyzer r-f oscillator. This difference should be 40-50 mc/s.

(14) Set the SELECTOR switch S-103 in either the SPECTRUM or the SPECTRUM AMPLIFIED position. The frequency meter pip illustrated in Fig. 2-5 should now appear as shown in Fig. 2-6. However, it is customary to operate the Analyzer with the SPECTRUM WIDTH control R-153 adjusted so that the

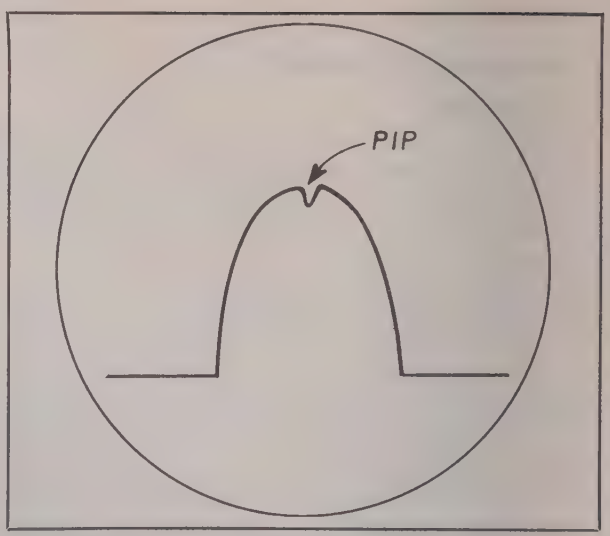


Figure 2-5. Frequency Meter Pip in Analyzer R-F Oscillator Pattern

two indentations, which indicate the useful portion of the trace, are just beyond the ends of the trace. The resulting pattern is shown in Fig. 2-7. Only the baseline and the frequency meter pip appear in these patterns.

d. INDICATION OF CORRECT OPERATING CONDITION.

(1) If the steps outlined in Par. 2 of this section produce the required patterns on the scope screen, the sweep, indicator, analyzer r-f oscillator, i-f amplifier, and video circuits, together with the r-f plumbing can be assumed to be in good operating condition and ready for use.

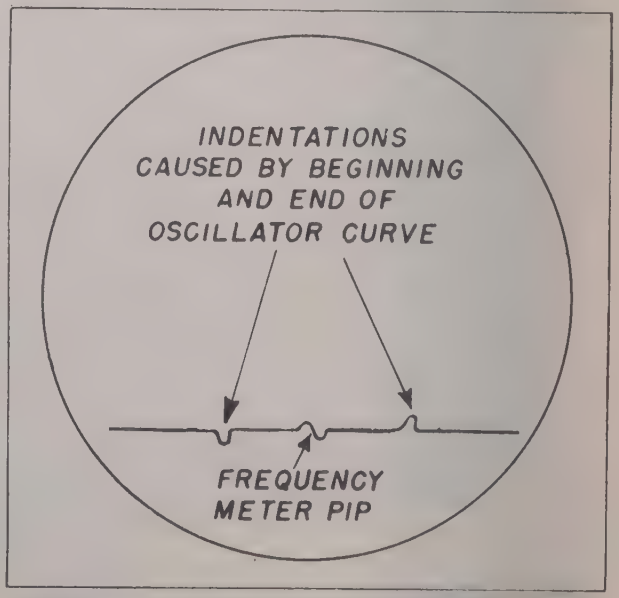


Figure 2-6. Frequency Meter Pip, SELECTOR Switch in SPECTRUM or SPECTRUM AMPLIFIED Position

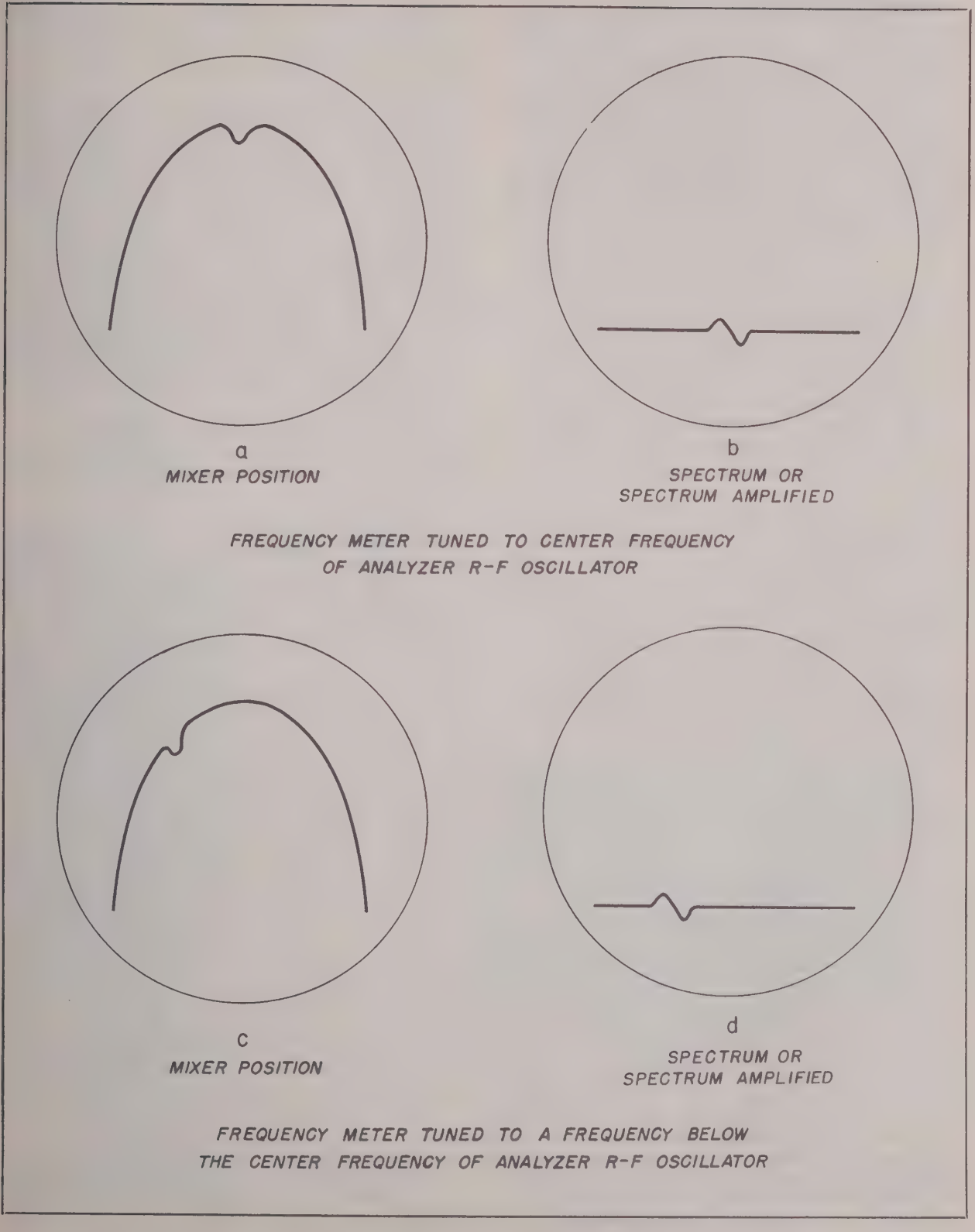


Figure 2-7. Analyzer R-F Oscillator Pattern, SPECTRUM WIDTH Control Properly Adjusted

3. DESCRIPTION OF CONTROLS.

a. PANEL CONTROLS.

(1) The INTENSITY control R-163 varies the intensity of the electron beam and the brilliance of the pattern on the scope screen. See Fig. 2-1.

(2) The OSCILLATOR FREQUENCY knob controls the frequency of oscillations in the analyzer r-f oscillator tube. This adjustment is illustrated in Fig. 2-1. Turning this control counterclockwise increases the frequency. A clockwise rotation decreases the frequency. This control selects the desired frequency range of the Analyzer by changing the dimensions of the cavity in the analyzer r-f oscillator.

CAUTION

Never force the OSCILLATOR FREQUENCY control or the Type 2K25 tube in the analyzer r-f oscillator may be damaged. All Type 2K25 tubes will not cover the full frequency range of the frequency meters, so care should be exercised, particularly toward the ends of the frequency range, to be certain the tuning mechanism is not being forced or broken.

(3) The SELECTOR switch S-103 has three positions:

(a) The first position is the MIXER position. This position is used when adjustments on the analyzer r-f oscillator are being made.

(b) The second position is the SPECTRUM position. When the switch is set to this position the *signal input* to the i-f amplifier is attenuated to reduce the effects of interference from other equipment.

(c) The third position is the SPECTRUM AMPLIFIED position. This position is similar to the second position except that the signal input to the i-f amplifier is not attenuated.

(4) The MIXER AMPLIFIER control R-127 regulates the amount of signal voltage that is applied to the grid of the d-c amplifier. This voltage is the d-c voltage taken from the crystal mixer in either the Analyzer or the radar set. In either case the rectified d-c signal voltage is developed from the output of the analyzer r-f oscillator.

(5) The SPECTRUM WIDTH control R-153 controls the amplitude of the sweep voltage that is applied to the reflector of the analyzer r-f oscillator. This voltage determines the width of the frequency band through which the analyzer r-f oscillator sweeps. Turning this control clockwise increases the number of megacycles per inch that is displayed.

(6) The SPECTRUM CENTER control R-167 controls the d-c potential on the reflector of the analyzer r-f oscillator and determines its mode of oscillation. This control provides a fine adjustment for the OSCILLATOR FREQUENCY control to center the spectrum on the screen. Turning this control clockwise causes the pattern to move to the right. Counterclockwise rotation moves the pattern to the left.

(7) The FREQUENCY control E-101A tunes the frequency meter by varying the length of its resonant cavity. A clockwise rotation increases the resonant frequency of the cavity. This control is directly calibrated in megacycles. Its range is 8470 mc/s to 9630 mc/s.

(8) The SPECTRUM AMPLITUDE knob E-101B controls the attenuation of the r-f input to the Analyzer. The attenuator provides attenuation from three to 70 db. This control is not calibrated. It is used to control the amplitude of the pattern on the oscilloscope for both spectrum positions of the SELECTOR switch.

(9) The FOCUS control R-165 adjusts the potential on the second grid of the cathode-ray tube and controls the sharpness of the trace.

(10) The MIXER AMPLIFIER jack J-101 provides an external connection to the input circuit of the d-c mixer amplifier. When this pack is used, the crystal mixer in the radar transmitter-converter replaces the crystal mixer in the Analyzer.

(11) The SYNC switch S-102 locks the start of the sweep to the a-c voltage in the power supply to synchronize the Analyzer with the line frequency when desirable.

(12) The POWER switch S-101 turns the a-c power ON and OFF.

(13) The SWEEP FREQUENCY control R-135 controls the sweep frequency of the trace on the cathode-ray tube. This control adjusts the sweep frequency between 10 and 30 cps. The sweep frequency is usually kept as low as possible.

Note

It is recommended that the two controls, VERTICAL MIXER and VERTICAL SPECTRUM, located behind the hinged plate marked VERTICAL CENTER should be adjusted by experienced personnel, or by operating personnel under the direct supervision of experienced personnel.

(14) The VERTICAL MIXER control R-133 is a screwdriver adjustment accessible from the front panel. It provides vertical centering when the SELECTOR switch is in the MIXER position.

(15) The VERTICAL SPECTRUM control R-117 is a screwdriver control that provides vertical centering when the SELECTOR switch is in the SPECTRUM or SPECTRUM AMPLIFIED positions.

WARNING

THIS EQUIPMENT EMPLOYS HIGH VOLTAGES WHICH ARE DANGEROUS AND MAY BE FATAL IF CONTACTED BY OPERATING PERSONNEL. EXTREME CAUTION SHOULD BE EXERCISED WHEN WORKING INSIDE THE CHASSIS.

b. CHASSIS CONTROLS.

Note

The dust cover must be removed to obtain access to the chassis controls. The location of these controls is shown in Fig. 2-3.

(1) The +300 VOLTAGE ADJUSTMENT R-182 is a screwdriver adjustment located in the rear corner on the left-hand side of the chassis. It controls the regulated 300-volt output from the power supply. A convenient terminal, marked +300 volts may be found on the top terminal of resistor R-134 which is located at the front of the terminal board on top of the chassis.

(2) The SPOT ADJUSTMENT control R-174 is on the left side of the +300 VOLTAGE ADJUSTMENT control when looking over the control panel toward the rear of the chassis. See Fig. 2-3. It controls the sharpness of the pattern on the cathode-ray tube. This control is set when a cathode-ray tube is installed and need not be disturbed again until the tube is replaced.

(3) The HUM ADJUSTMENT control R-193 is directly in front of the two controls just described. It controls the hum level that appears on the oscilloscope.

(4) The HORIZONTAL CENTERING control R-144 is located directly in front of V-112 in Fig. 2-3. It centers the trace on the screen of the oscilloscope tube.

(5) The HORIZONTAL AMPLITUDE control R-140 is directly in front of V-108 in Fig. 2-3. It controls the length of the trace on the scope screen.

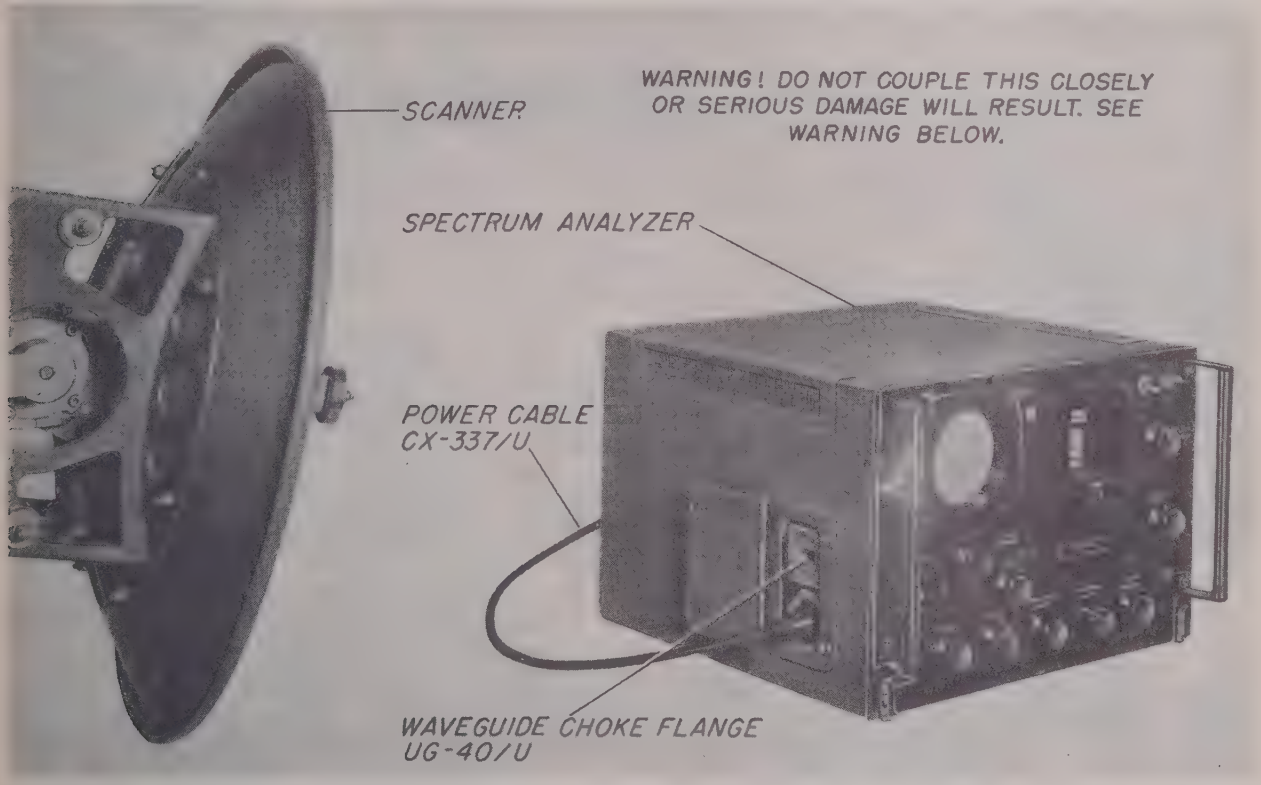
(6) The SENSITIVITY control R-197, located beneath the chassis near transformer T-102 is used to control the gain of V-101 when the SELECTOR switch is in the SPECTRUM position. It is used to set the i-f gain at 25 db below the gain obtained in the SPECTRUM AMPLIFIED position.

4. PERFORMANCE CAPABILITIES.

a. The Spectrum Analyzer, within the limitation of its frequency range, may be used to perform the following tests:

Note

Due to backlash, parallax, and tuning errors, the accuracy of the frequency meter may be reduced in extreme cases to ±2 mc/s at the check point. The error may increase to as much as ±5 mc/s at other points on the dial.


SCANNER
WARNING! DO NOT COUPLE THIS CLOSELY OR SERIOUS DAMAGE WILL RESULT. SEE WARNING BELOW.
SPECTRUM ANALYZER
POWER CABLE CX-337/U
WAVEGUIDE CHOKE FLANGE UG-40/U

WARNING

THIS FIGURE ILLUSTRATES A PRINCIPLE OF COUPLING. IN PRACTICE THE EQUIPMENTS ARE NEVER PLACED THIS CLOSE TOGETHER. TO DO SO WOULD BURN OUT THE ATTENUATOR AND CRYSTAL MIXER IN THE ANALYZER.

Figure 2-8. Use of Open Wave Guide to Pick Up Output of Magnetron

However, the average reading will be much more accurate. The frequency meter cavity is zero set for 9310 mc/s in an approximate ambient temperature of 21°C. and an approximate relative atmospheric humidity of 60 per cent. If the Analyzer is operated under temperature and humidity conditions that vary appreciably from the values given, the error in calibration will increase.

(1) Observation of the spectra of various types of micro-wave oscillators used in radar systems. The Analyzer is particularly useful for observing spectra of pulsed magnetrons. It is possible to adjust a magnetron spectrum for optimum operating efficiency with the aid of the Analyzer.

(2) Measurement of magnetron frequencies.

(3) Observation of the operation of radar local oscillators with respect to their associated magnetrons. In connection with the radar local oscillator, the Analyzer may also be used to check AFC operation and analyze troubles in the AFC circuit. External local oscillators can be tuned with an accuracy of ±2 mc/s if their frequency is near the zero check point (931) on the dial of the frequency meter.

(4) Tuning plumbing in a radar transmitter-converter. This procedure requires a previous knowledge of the frequency of the magnetron.

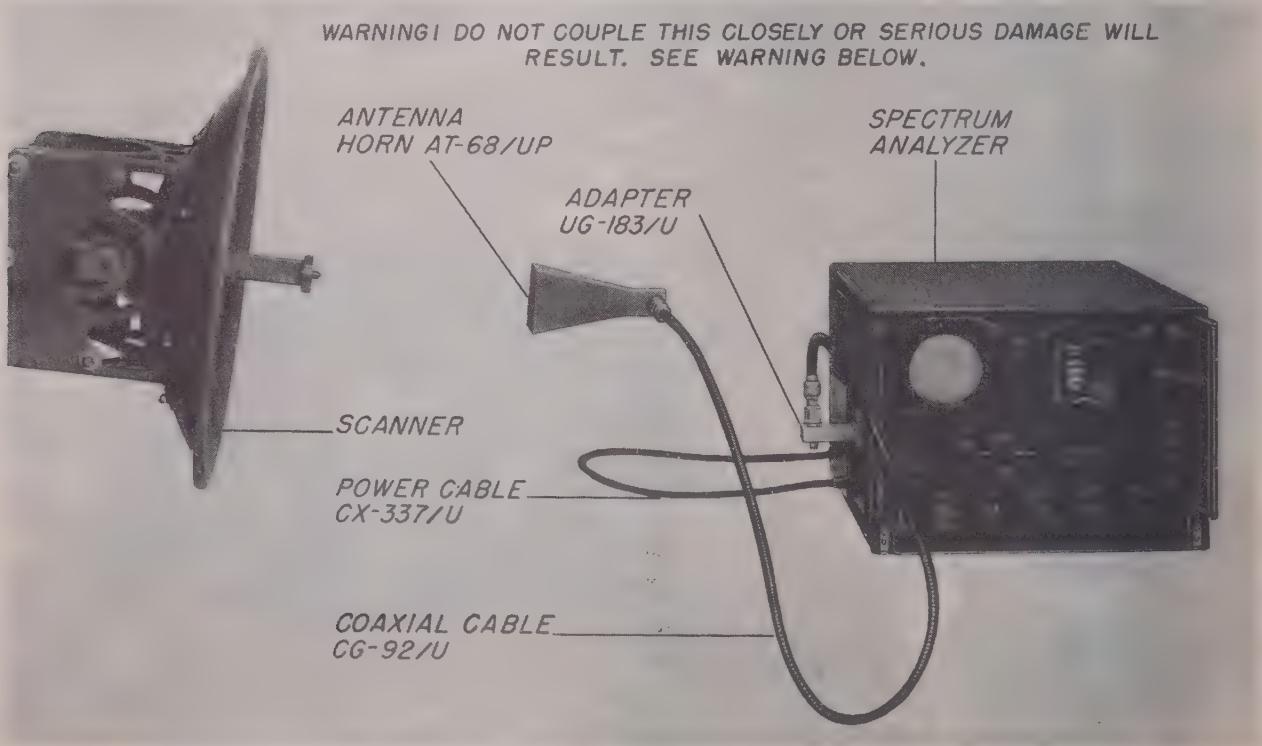
(5) Checking or setting the resonant frequencies of frequency meters, T/R Boxes, R/T Boxes and echo boxes. This test is performed by observing the reaction of the device under test on the output curve of the analyzer r-f oscillator, and then measuring the frequency with the frequency meter in the Analyzer. The Analyzer may be operated as a CW or FM signal generator for this test. The Analyzer approaches CW operation when the SPECTRUM WIDTH control is in its minimum position.

(6) Performance tester for local oscillator tubes. Type 2K25 and 723A/B tubes may be tested by inserting them in the analyzer r-f oscillator socket and checking their output curves on the scope when the SELECTOR switch is in the MIXER position.

(7) Measurement of band-widths of resonant cavities.

(8) Measurements of pulse-widths. This measurement is an approximation and is satisfactory for most practical purposes.

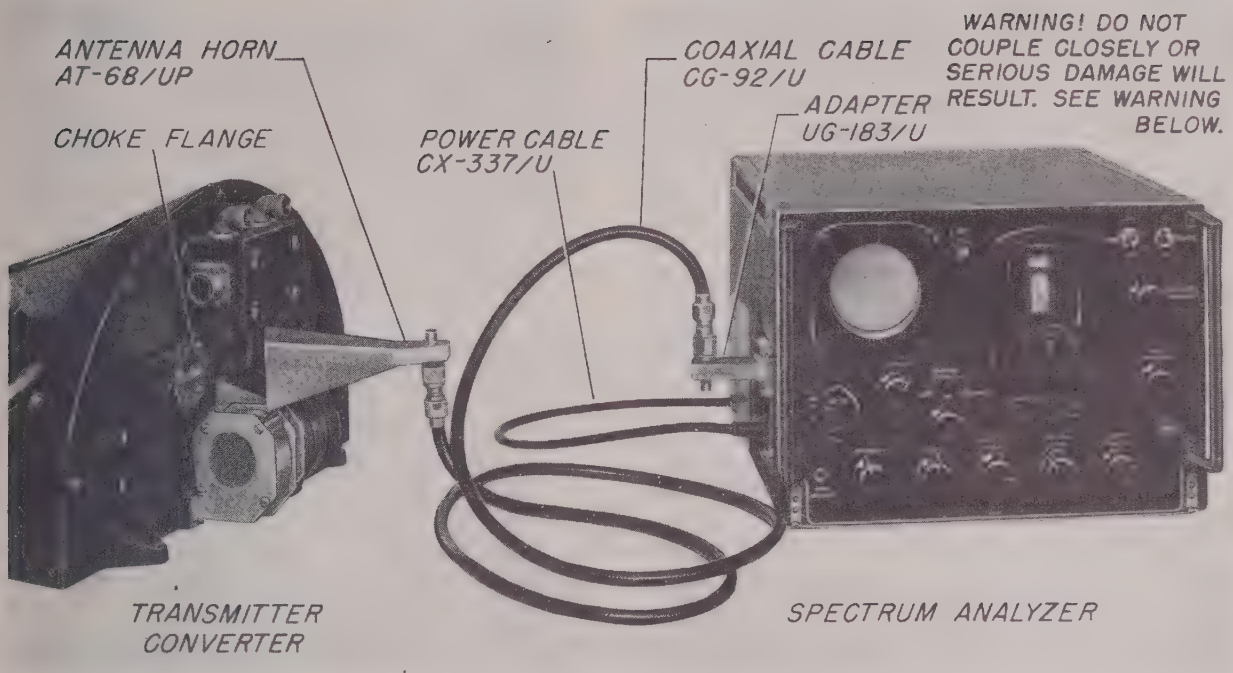
(9) Measurement of the distribution of useful transmitted power. The vertical height of each fre-


WARNING! DO NOT COUPLE THIS CLOSELY OR SERIOUS DAMAGE WILL RESULT. SEE WARNING BELOW.
ANTENNA HORN AT-68/UP
SPECTRUM ANALYZER
ADAPTER UG-183/U
SCANNER
POWER CABLE CX-337/U
COAXIAL CABLE CG-92/U

WARNING

THIS FIGURE ILLUSTRATES A PRINCIPLE OF COUPLING. IN PRACTICE THE EQUIPMENTS ARE NEVER PLACED THIS CLOSE TOGETHER. TO DO SO WOULD BURN OUT THE ATTENUATOR AND CRYSTAL MIXER IN THE ANALYZER.

Figure 2-9. Use of Antenna Horn to Pick Up Magnetron Output from Scanner



WARNING

THIS FIGURE ILLUSTRATES A PRINCIPLE OF COUPLING. IN PRACTICE THE EQUIPMENTS ARE NEVER PLACED THIS CLOSE TOGETHER. TO DO SO WOULD BURN OUT THE ATTENUATOR AND CRYSTAL MIXER IN THE ANALYZER.

Figure 2-10. Antenna Horn Placed Near Choke Flange on Radar Transmitter-Converter

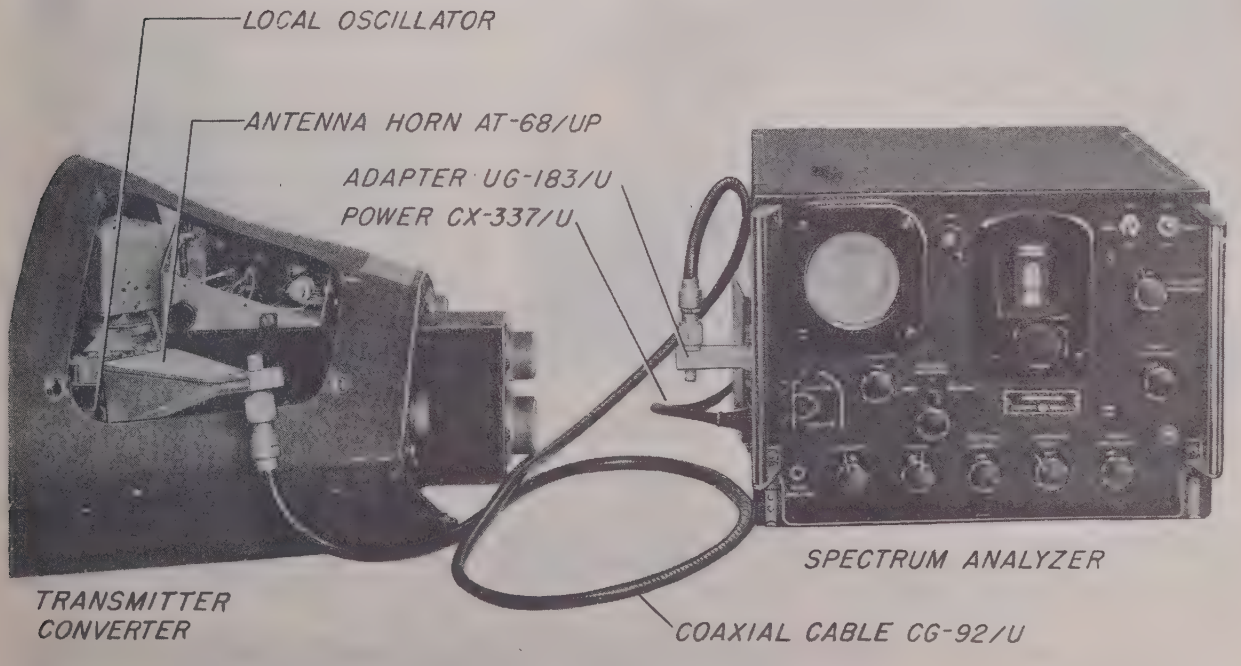


Figure 2-11. Use of Antenna Horn to Pick Up Output of Radar Local Oscillator and Magnetron

quency component in the spectrum is proportional to its contribution to the total transmitted power.

5. PROCEDURE FOR THE OBSERVATION OF SPECTRA.

a. To observe the spectrum of a magnetron or other oscillator, make the following preliminary adjustments after the Analyzer has been installed and turned on as outlined in Par. 2 of this section.

(1) Place the SELECTOR switch in its MIXER position.

(2) Turn the SPECTRUM WIDTH control in a clockwise direction until its setting is nearly maximum.

(3) Center the bell-shaped hump on the trace with the SPECTRUM CENTER control.

(4) Place the SELECTOR switch in its SPECTRUM or SPECTRUM AMPLIFIED position. Use the SPECTRUM AMPLIFIED position if there is no likelihood of interference from any adjacent radar equipment. If interference occurs, use the SPECTRUM position.

(5) Point the wave-guide, which is accessible through the little side door, at the radar antenna or to the magnetron output. This method of coupling is illustrated in principle in Fig. 2-8. In practice the equipments are never placed so close together. To do so would burn out the attenuator and crystal mixer in the Analyzer and probably pull the magnetron.

(6) If this method of coupling is not practical, the Antenna Horn and fittings may be used as illustrated in Fig. 2-9. These parts are carried in the Auxiliary and Spare Parts case. Fig. 2-9 illustrates the principle of a method of coupling. The Antenna Horn should never be placed so close to a radar antenna. This method can be used to pick up the output of the magnetron at distances up to 100 feet if the two antennas are pointing directly at each other.

CAUTION

NEVER ATTEMPT TO INCREASE THE AMPLITUDE OF THE SPECTRUM BY INCREASING THE COUPLING UNTIL IT IS ASCERTAINED THAT THE AMPLITUDE CANNOT BE INCREASED BY ADJUSTING THE SPECTRUM AMPLITUDE CONTROL (ATTENUATOR) OR BY PLACING THE SELECTOR SWITCH IN ITS SPECTRUM AMPLIFIED POSITION OR BOTH. CLOSE COUPLING WILL BURN OUT THE RESISTANCE CARDS IN THE ATTENUATOR AND RUIN THE CRYSTAL IN THE CRYSTAL MIXER OF THE ANALYZER.

(7) The Antenna Horn may also be pointed toward the choke flange joints in the radar transmitter-converter or be placed in a position just back of the

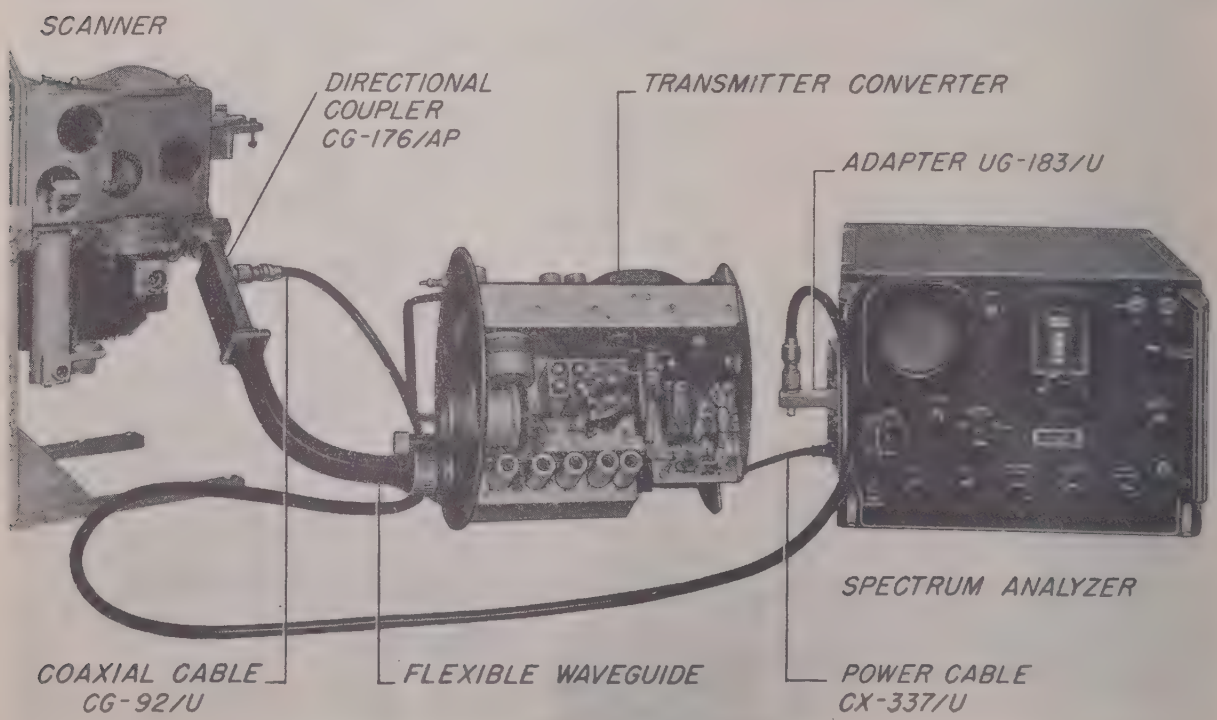


Figure 2-12. Obtaining Stable Coupling with Directional Coupler CG-176/AP

radar antenna. It will pick up sufficient power in either position. These methods of coupling are illustrated in principle in Fig. 2-10. *Do not overcouple when using these methods.*

(8) The Antenna Horn may also be pointed at local oscillators in radar sets and other equipment in order to obtain their spectra for observation. See Fig. 2-11. It is seldom necessary to remove the shield cover of the local oscillator. The magnetron spectrum and local oscillator spectrum may both be observed simultaneously if a proper location for the Antenna Horn is found that produces sufficient attenuation of the output of the magnetron.

(9) If a very stable method of coupling is desired, remove the Antenna Horn from the coaxial cable and connect the cable to a Type CG-176/AP directional coupler or wave selector that has been inserted at some convenient place in the line. This connection is shown in Fig. 2-12. The Analyzer receives approximately one per cent of the power in the directional coupler. This method is very satisfactory when it is necessary to check the antenna when it is in motion, to see if it is pulling the frequency of the magnetron.

(10) Adjust the SPECTRUM AMPLITUDE control to obtain the desired amplitude on the screen.

CAUTION

Do not connect the output of the magnetron directly into the Spectrum Analyzer. To do so would burn up the resistance card in the attenuator and burn out the crystal even though the Spectrum Analyzer is turned off.

6. OBSERVATION OF PATTERNS.

a. OBTAINING CORRECT PATTERN APPEARANCE.

(1) Rotate the SPECTRUM WIDTH control counterclockwise until the spectrum gains sufficient detail to make observation easy. If more pulses are desired in the spectrum turn the SWEEP FREQUENCY control counterclockwise to a lower sweep frequency.

b. OBSERVATION OF FREQUENCY-PULLING IN A MAGNETRON.

(1) Frequency pulling describes the shift in magnetron frequency caused by improper loading and line voltage. Pulling is identified by the horizontal shift in the scope pattern when the antenna is rotated by hand. The coupling method in Fig. 2-12 permits tests with the antenna rotating at normal speed. Excessive pulling disrupts AFC action which impairs operating efficiency. See Par. 7*b*(3) of this section. When the SYNC switch is ON, line frequency pulling is eliminated from the displayed spectrum. When the SYNC switch is OFF, pulling due to line voltage effects and magnetron load changes will be present.

c. MEASUREMENT OF MAGNETRON FREQUENCY.

(1) The frequency meter pip, that is visible when the SELECTOR switch is in the MIXER position, represents the actual frequency of the frequency meter that is indicated on the dial. When the SELECTOR switch is in either of its other two positions for frequency measurements, the pip is adjusted to coincide with the unknown frequency by rotating the dial marked FREQUENCY. *The reading on this dial does not represent the frequency that is being measured.* The unknown frequency *must be computed from the dial reading* by adding or subtracting the 22.5-megacycle intermediate frequency of the Analyzer.

(2) It is possible to see two different images as will be explained presently. Whether the intermediate frequency is added or subtracted depends upon the image with which the frequency meter pip is made to coincide. If the image is the one on the right, indicated as R, in Fig. 2-13, it is necessary to sub-

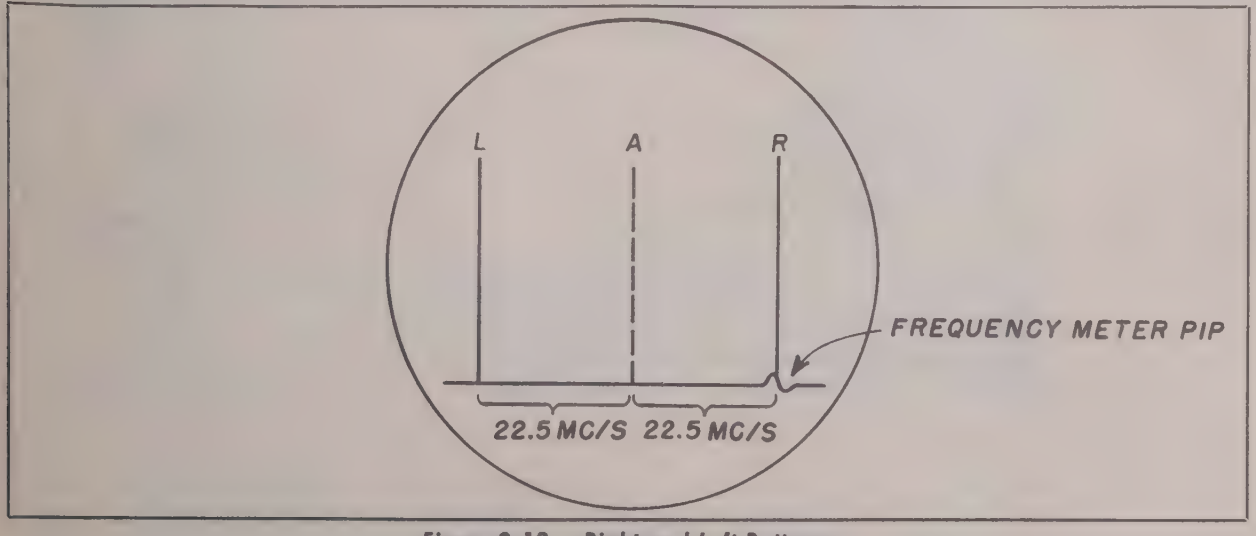
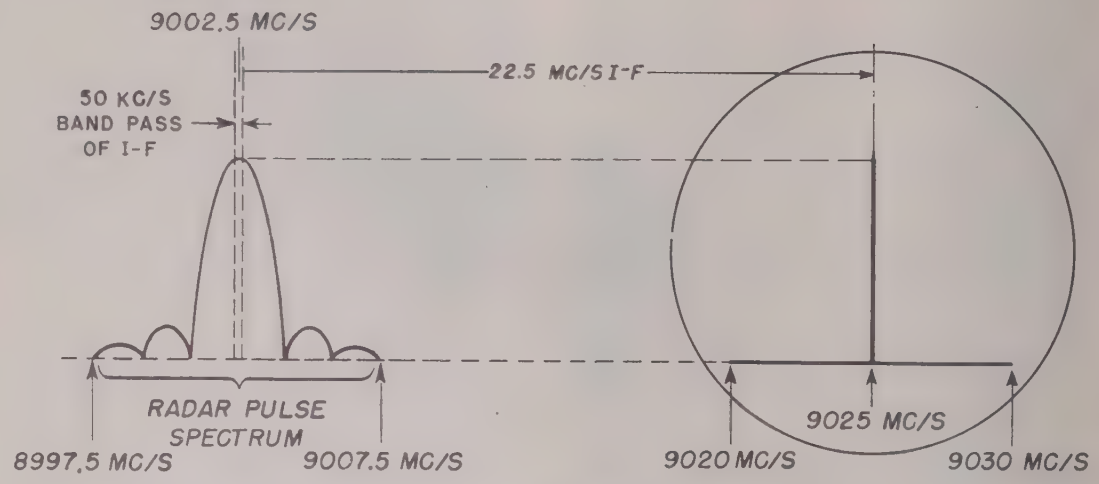
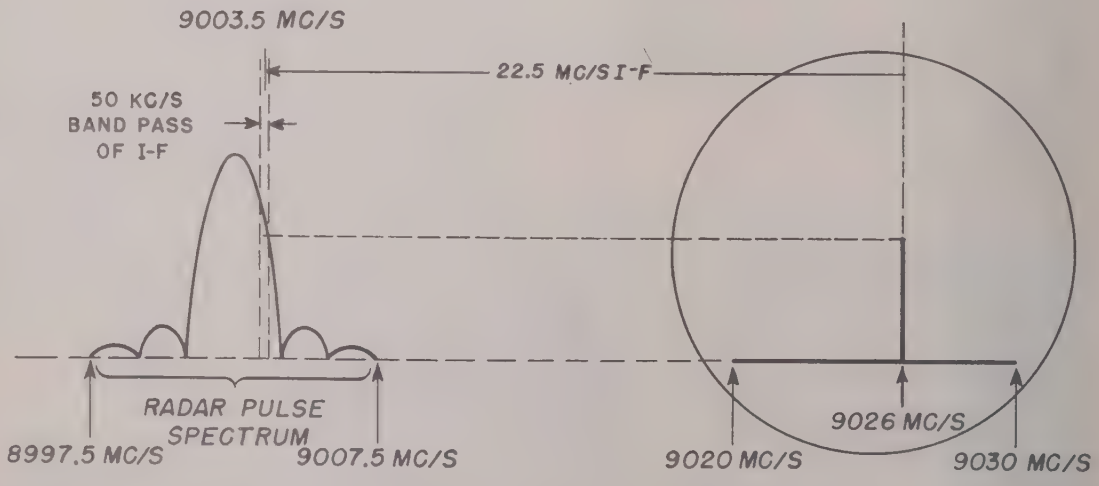


Figure 2-13. Right and Left Patterns



a. ANALYZER RF OSCILLATOR AT 9025 MCS.



b. SAME AS 2-14a EXCEPT THAT A DIFFERENT FREQUENCY COMPONENT HAS APPEARED BECAUSE THE ANALYZER RF OSCILLATOR IS NOW AT 9026 MC/S. NOTE THAT 50 KC/S SLIT THROUGH WHICH THE SPECTRUM CAN BE SEEN, HAS MOVED TO THE RIGHT.

Figure 2-14. Sweep of the Analyzer R-F Oscillator Over the Spectrum

tract 22.5 mc/s from the dial reading. The remainder thus obtained represents the frequency of the unknown signal. If the image is the one on the left, indicated as L, in Fig. 2-13, it is necessary to add 22.5 mc/s to the dial reading. To determine which image is under observation, refer to Fig. 2-13 and the explanation that follows.

(3) Fig. 2-13 shows the scope screen with the SPECTRUM WIDTH control set to show both images. The frequency of the analyzer r-f oscillator increases as the sweep progresses from left to right across the screen. Therefore, both images can always be made to appear on the screen although, in actual practice, one is centered on the screen so that the other does not appear. These images are always identical and either one can be selected for the frequency measurement. The actual signal frequency is not represented by a vertical line. If it were, the vertical line would lie midway between L and R on the dotted line marked A.

(4) The reason two images appear is due to the action of the analyzer r-f oscillator. It sweeps through a band of frequencies in synchronism with the scope trace. As it reaches a frequency that is 22.5 mc/s below the frequency of the unknown signal, the image marked L appears. As the frequency sweep of the analyzer r-f oscillator continues, it passes through a frequency that is 22.5 mc/s above the frequency of the unknown signal. At this time, the signals again heterodyne and the image marked R appears on the trace.

(5) When the frequency of the analyzer r-f oscillator passes through the unknown frequency, a zero frequency beat is obtained and consequently no deflection voltage can be applied to the vertical plates of the cathode-ray tube. It is true that many beat frequencies are obtained during each frequency sweep, but since the i-f amplifier is sharply tuned for a band-width of 50 kc/s, indications cannot be obtained at any frequency other than 22.5 mc/s $\pm$ .025 mc/s as shown in Fig. 2-14.

(6) If the frequency meter is tuned so that its pip coincides with the right-hand image (R) as shown in Fig. 2-13, its dial reading represents the frequency of the analyzer r-f oscillator which is 22.5 mc/s above the unknown frequency. Therefore, 22.5 mc/s must be subtracted from the dial reading to obtain the frequency of the unknown signal.

(7) If the frequency meter is tuned so that its pip coincides with the left-hand image (L), its dial reading represents the frequency of the analyzer r-f oscillator which is now 22.5 mc/s below the frequency of the unknown signal. In this case, 22.5 mc/s must be added to the dial reading to obtain the unknown frequency.

(8) Another method for obtaining the unknown frequency is to take a reading on each image and average the two readings.

Example:

Dial reading for image L = 9000 mc/s.

Dial reading for image R = 9045 mc/s.

Unknown frequency

$$= \frac{9000 + 9045}{2} = \frac{18045}{2} = 9022.5 \text{ mc/s.}$$

(9) Another very accurate method may be used if the unknown signal is stably coupled to the Analyzer as, for example, with directional coupler Type CG-176/AP. This method consists of tuning the frequency meter until its pip is equidistant from the two images. Both images must be carefully observed while the frequency meter is being tuned. At the instant the resonant frequency of the frequency meter equals the frequency of the unknown signal, it will be possible to see both images dip simultaneously. The reduction in amplitude occurs because the frequency meter absorbs energy from the unknown signal frequency. In this case the reading on the FREQUENCY dial represents the actual frequency of the unknown signal.

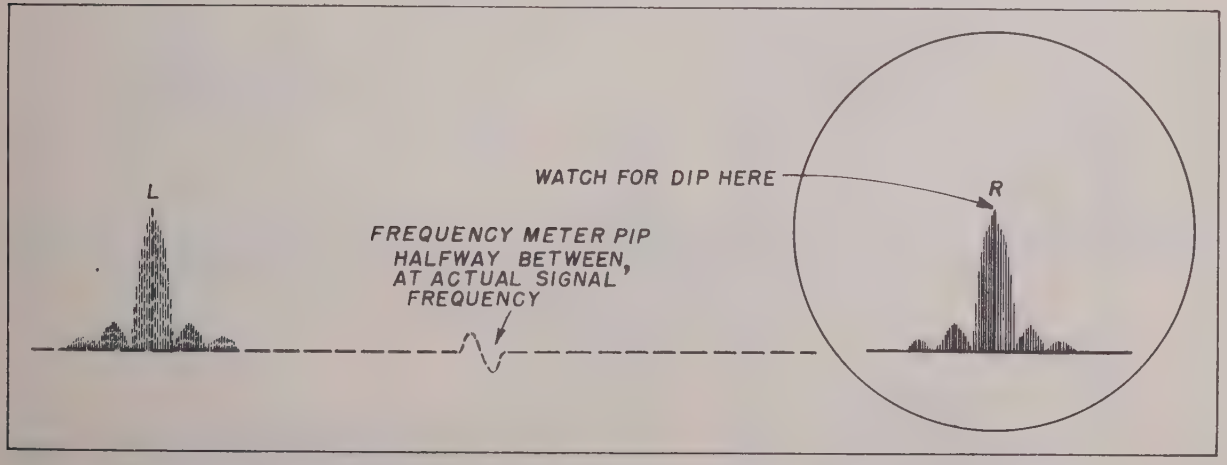


Figure 2-15. Determination of Frequency by Tuning Frequency Meter for Dip in Spectrum

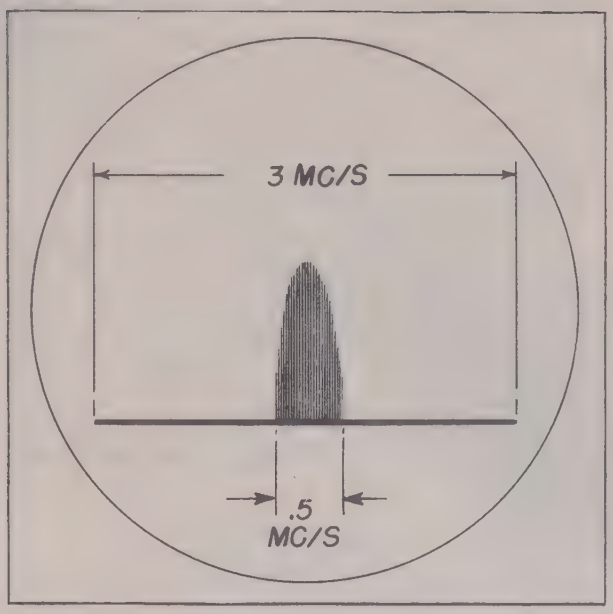


Figure 2-16. Spectrum of Radar Local Oscillator with AFC

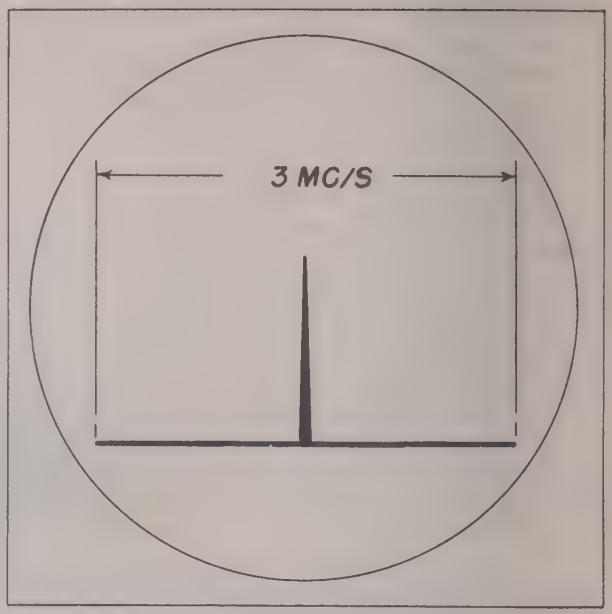


Figure 2-17. Spectrum of Radar Local Oscillator without AFC

(10) A variation of this method is to center one of the images with the SPECTRUM CENTER control and spread the spectrum with the SPECTRUM WIDTH control so that the dip can be distinguished easily when the frequency meter is tuned to the unknown frequency. This method is illustrated in Fig. 2-15.

7. OBSERVATION OF LOCAL OSCILLATOR SPECTRA.

a. GENERAL.

(1) The operation of radar local oscillators can be observed, using the method illustrated in Fig. 2-11. Turn the SPECTRUM WIDTH control counter-

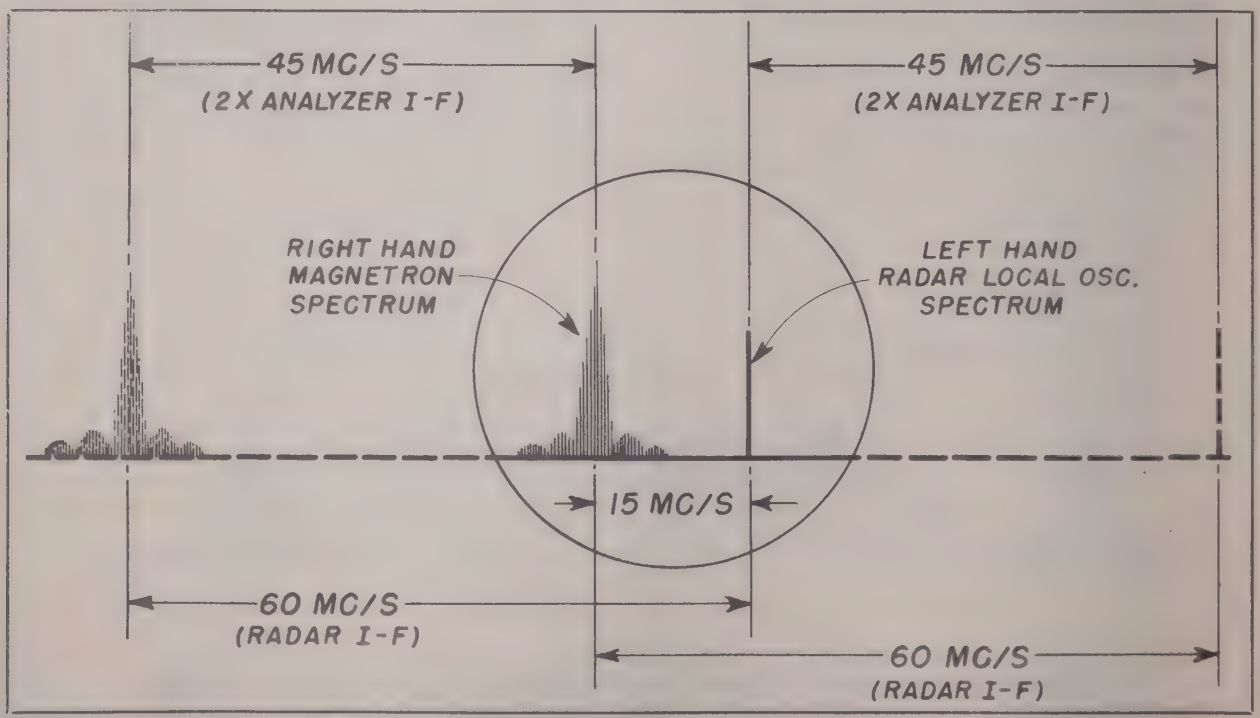


Figure 2-18. Measuring the Frequency of a Local Oscillator that is 60 Megacycles Above the Magnetron

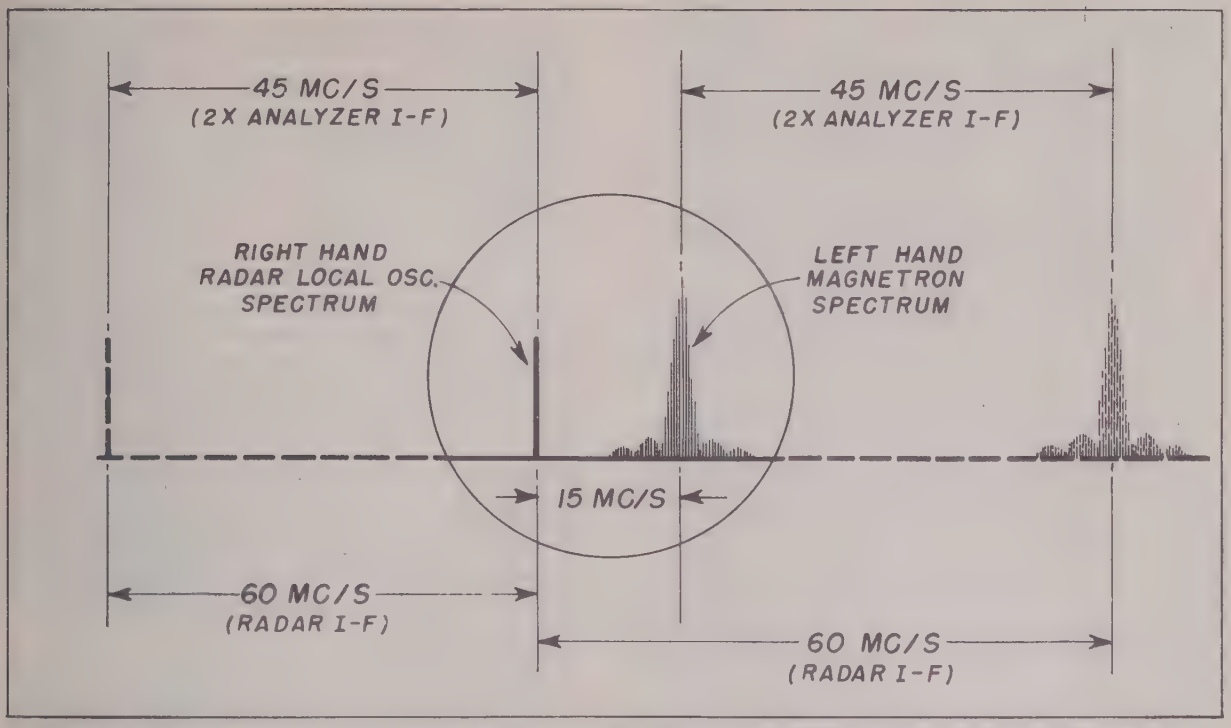


Figure 2-19. Measuring the Frequency of a Local Oscillator that is 60 Megacycles Below the Magnetron

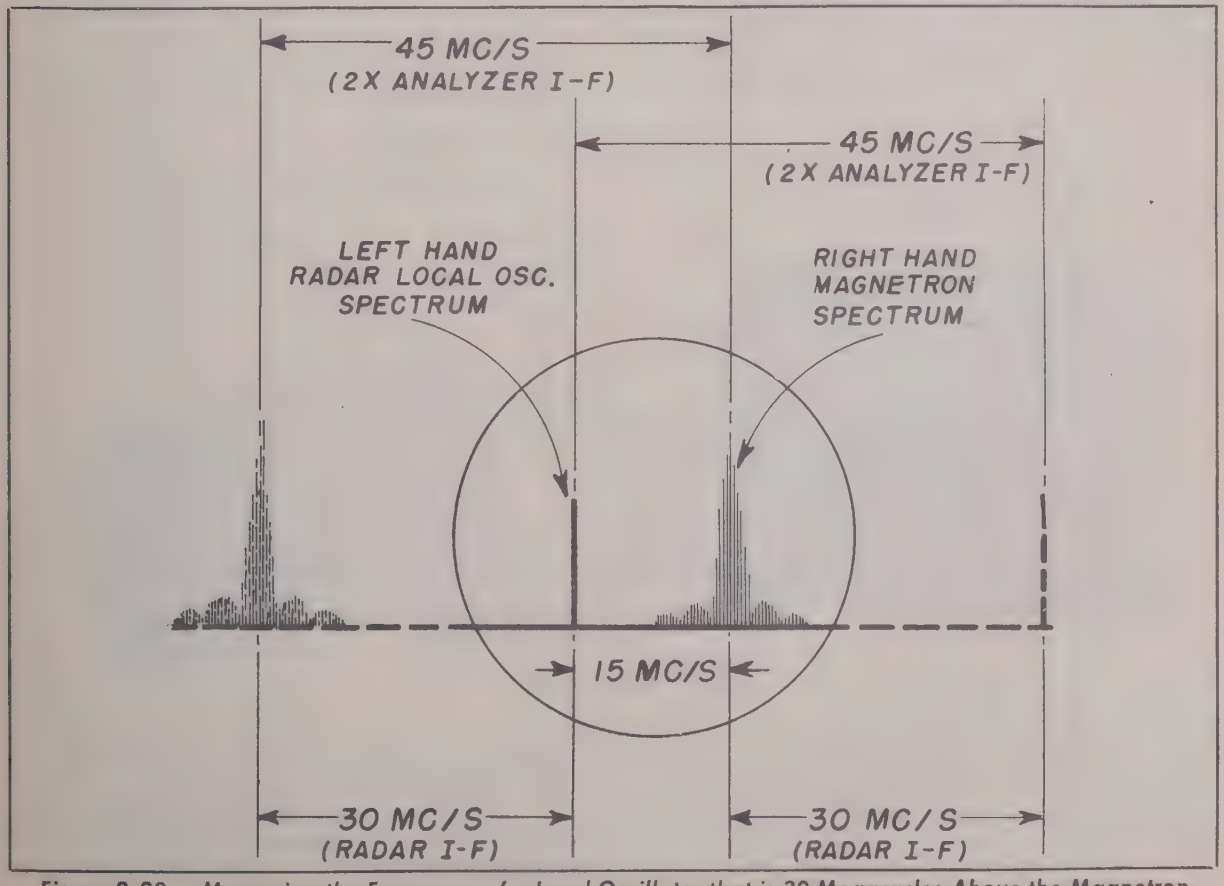


Figure 2-20. Measuring the Frequency of a Local Oscillator that is 30 Megacycles Above the Magnetron

clockwise until the width of the spectrum across the screen is approximately 3 mc/s. Under this condition, the spectrum of a radar local oscillator operating on AFC, will usually cover about one-half to three megacycles on the screen. See Fig. 2-16. When the AFC action is discontinued and the frequency is controlled manually, the local oscillator produces a single pip that is fairly stable unless its power supply has excessive ripple in its output voltage. See Fig. 2-17.

b. MEASUREMENTS OF RADAR LOCAL OSCILLATOR FREQUENCY.

(1) There are two similar methods for measuring the frequency of a radar local oscillator. The choice of methods depends upon whether the intermediate frequency is 30 mc/s or 60 mc/s.

(2) If the intermediate frequency is 60 mc/s it would be assumed, under normal conditions, that the radar local oscillator was running at a frequency 60 mc/s above the magnetron frequency. Since two frequencies that are 60 mc/s apart cannot be seen on the scope at the same time, a unique use is made of the fact that two spectrum images appear for each signal. In practice, the right-hand spectrum of the magnetron is placed on the left-hand side of the scope. Then the left-hand spectrum of the radar local oscillator should appear on the right-hand side of the scope. The resulting pattern is illustrated in Fig. 2-18.

(3) An examination of Fig. 2-18 shows that it is easy to determine whether the AFC action is causing the radar local oscillator to follow closely the excursions of the magnetron frequency. The pattern inside the circle is the pattern selected by the SPECTRUM CENTER control to appear on the screen. The pattern represented by the dotted line does not appear but is shown to illustrate the frequency relationship of the two images that do appear.

(4) The accuracy with which the radar local oscillator tracks the magnetron can be determined by measuring the difference between the frequencies of the two images on the screen. Rotate the FREQUENCY dial, to set the frequency meter pip under the center of the magnetron spectrum, and note the dial reading. Then set the pip under the radar local oscillator pip and again note the dial readings. If the difference between the dial readings is 15 mc/s, the radar local oscillator (or AFC discriminator) has been accurately set to the proper frequency. If the frequency of the radar local oscillator is set below the magnetron frequency the position of the images would be reversed as shown in Fig. 2-19.

(5) If the intermediate frequency is 30 mc/s the procedure is similar to the one above except that the

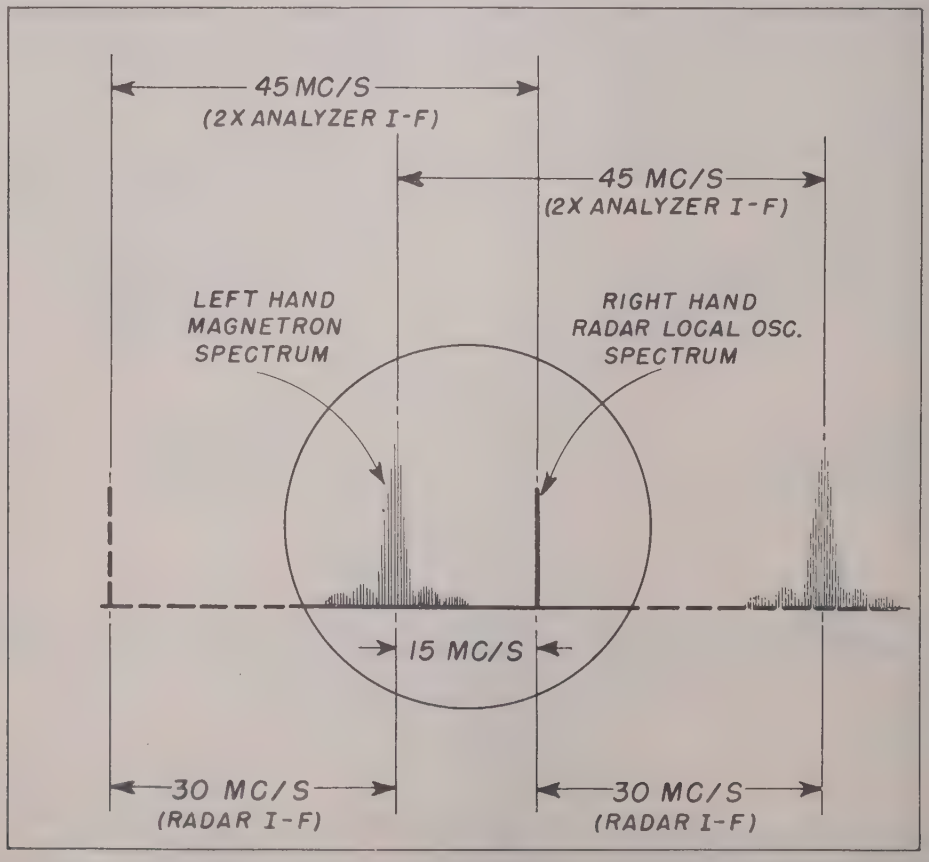


Figure 2-21. Measuring the Frequency of a Local Oscillator that is 30 Megacycles Below the Magnetron

position of the images on the screen is reversed. The left-hand spectrum of the radar local oscillator appears on the left side of the screen while the spectrum of the magnetron now appears on the right. This condition is shown in Fig. 2-20. The difference in frequencies is measured just as it was in the foregoing method and a frequency difference of 15 mc/s indicates that the local oscillator is running at a frequency 30 mc/s above the magnetron.

(6) If the radar local oscillator runs below the magnetron frequency, the position of the images would be reversed as shown in Fig. 2-21. That is, the radar local oscillator spectrum would be on the right and the magnetron spectrum would be on the left.

c. FREQUENCY MEASUREMENT OF BEACON LOCAL OSCILLATORS.

(1) The same method described in Par. 7*b* of this section may also be used to check the operation of the beacon local oscillator. If the beacon local oscillator is out of adjustment the Analyzer can be used to set it to an accuracy of ±2 mc/s under normal conditions of temperature and humidity. If better accuracy is desired, it can be obtained by the use of a standard cavity tuned to the beacon local oscillator frequency. See Par. 8*a*(12) of this section. See Note in Par. 4*a* of this section.

(2) It was assumed in the foregoing remarks that the beacon local oscillator was AFC controlled. Under this condition the beacon local oscillator spectrum will occupy a width of about one-half of a megacycle. Swept beacon oscillators, as in the AN/APS-4, can be observed by setting the SWEEP FREQUENCY control, (with the SYNC switch OFF) just out of synchronism with the beacon sweep rate. One or two beacon pips can be seen drifting through the oscillator's full frequency range.

8. TUNING R-F PLUMBING IN A RADAR SET.

a. For this application, the Spectrum Analyzer is used as a frequency-modulated signal generator. The scope screen presents a dynamic pattern of the band-pass characteristic of the r-f plumbing. To tune r-f plumbing proceed as follows:

(1) The first step is to measure the frequency of the magnetron, using the procedure outlined in Par. 6*c* of this section. The permissible tolerance is ±5 mc/s. Set the FREQUENCY dial to the *actual* frequency of the magnetron.

(2) Turn off the magnetron and local oscillator in the radar set and couple the Analyzer to the wave-guide of the radar transmitter-converter with the flexible wave-guide that comes with the Analyzer. The flexible wave-guide is packed in the Auxiliary and Spare Parts Box. Any flexible wave-guide that will fit a Type UG-40/U choke flange may be used. If the use of the flexible wave-guide is not practical, the coaxial line and wave-guide-to-coaxial line adapter may be used. The use of the wave-guide is recommended due to the attenuation present in the coaxial line.

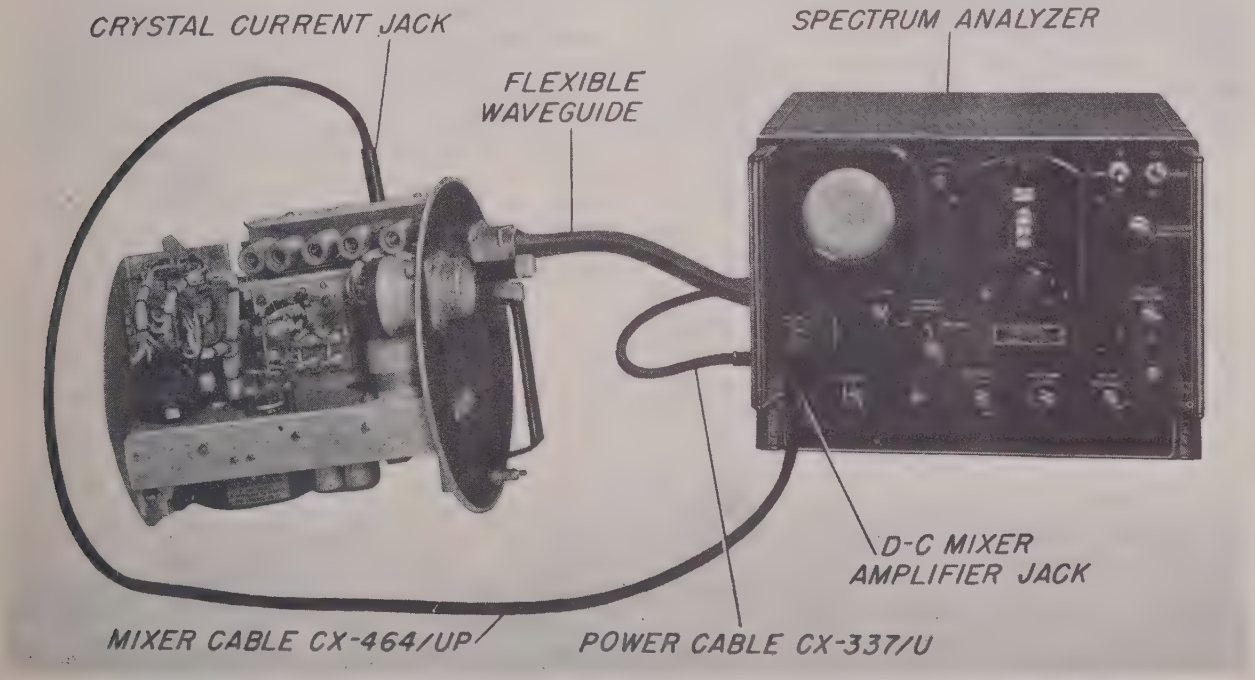


Figure 2-22. Spectrum Analyzer Coupled to Transmitter Converter to Tune R-F Plumbing

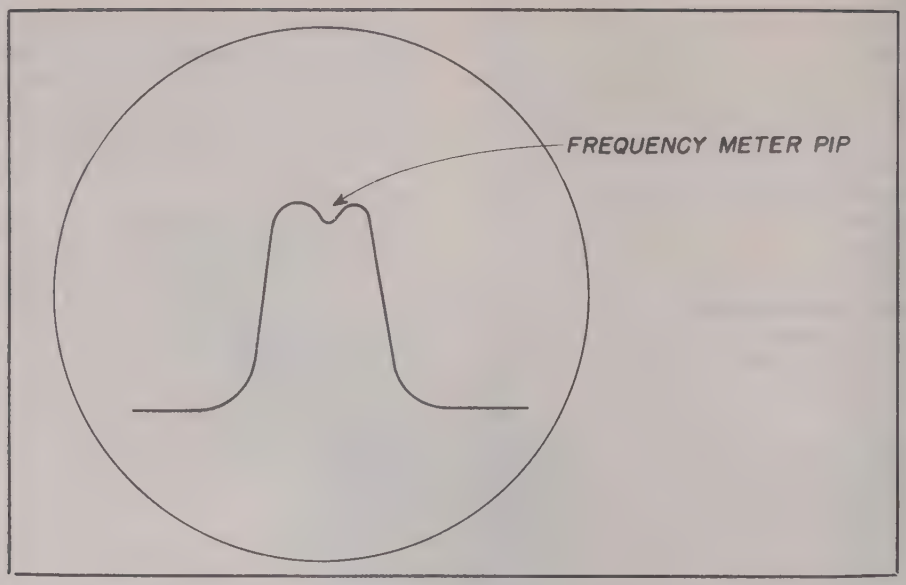


Figure 2-23. Bandpass Characteristic of a T/R Box

(3) The proper use of the wave-guide is illustrated in Fig. 2-22. Avoid bending the wave-guide any more than is absolutely necessary. It should be bent gently and carefully to avoid damage. Fig. 2-10 illustrates the use of the coaxial line.

CAUTION

DO NOT APPLY POWER TO THE MAGNETRON WHILE THE ANALYZER IS DIRECTLY COUPLED TO THE TRANSMITTER-CONVERTER. TO DO SO WILL DAMAGE THE ANALYZER.

(4) Place the SELECTOR switch in its MIXER position, and adjust the bell-shaped pattern with the OSCILLATOR FREQUENCY and SPECTRUM CENTER controls until the frequency meter pip is exactly centered on top of the pattern, as shown in Fig. 2-5. DO NOT ADJUST THE FREQUENCY METER during this operation.

(5) Turn the SPECTRUM AMPLITUDE control all of the way clockwise and plug the Type CX-464/UP cable into the radar crystal current jack on the radar transmitter-converter and the MIXER AMPLIFIER jack on the Analyzer. This effectively replaces the Analyzer mixer with the mixer in the radar transmitter-converter.

(6) Tune the T/R Box until a pattern similar to the one in Fig. 2-23 is obtained.

(7) Adjust the T/R Box until the frequency meter pip appears at the top of the pattern. This is the pattern that represents the band-pass characteristic of the T/R Box and its width can be measured with the

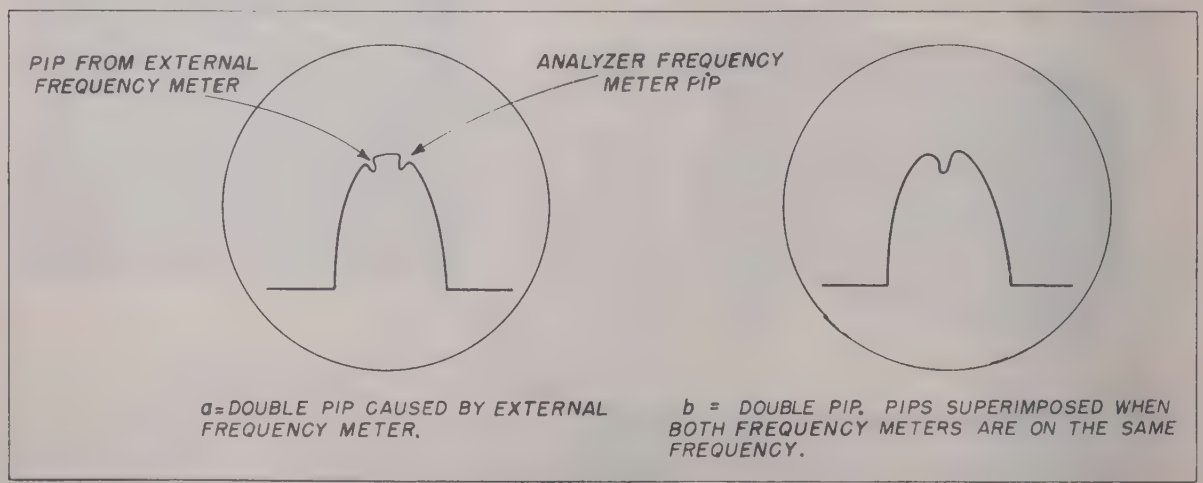
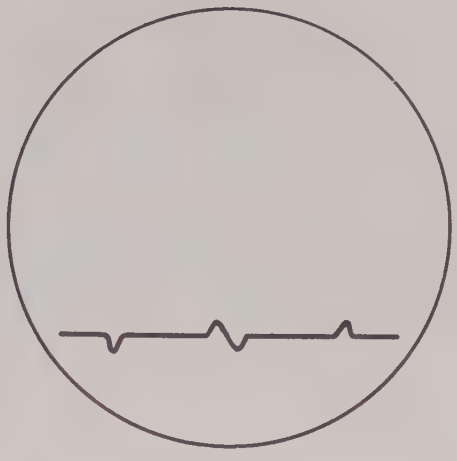

PIP FROM EXTERNAL FREQUENCY METER
ANALYZER FREQUENCY METER PIP
a=DOUBLE PIP CAUSED BY EXTERNAL FREQUENCY METER.
b = DOUBLE PIP. PIPS SUPERIMPOSED WHEN BOTH FREQUENCY METERS ARE ON THE SAME FREQUENCY.

Figure 2-24. Double Pip on Analyzer R-F Oscillator Pattern when Another Resonant Cavity is Coupled to the Analyzer

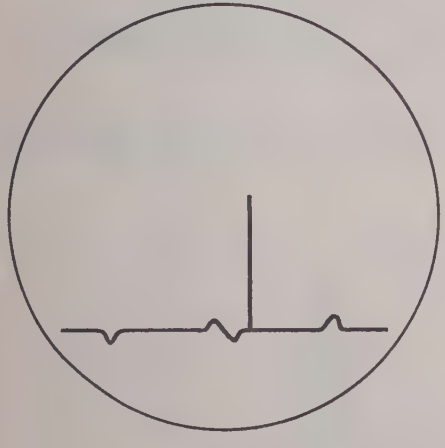
a. MIXER POSITION

NO SIGNAL PRESENT EXCEPT THAT OF ANALYZER R-F OSCILLATOR

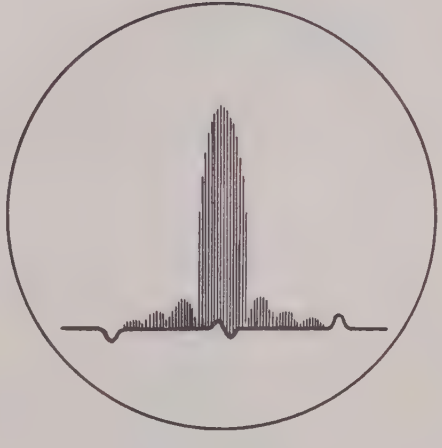


b. SPECTRUM OR SPECTRUM AMPLIFIED POSITION

NO OTHER SIGNAL PRESENT EXCEPT THAT OF ANALYZER R-F OSCILLATOR



c. CW SIGNAL



d. PULSED SIGNAL

MAXIMUM FREQUENCY SWEEP OF ANALYZER RF OSCILLATOR MAKES A LARGE NUMBER OF SIDE BANDS VISIBLE.

Figure 2-25. Representative CW and Pulsed Signals, SPECTRUM WIDTH Control Full Clockwise For Minimum Width

frequency meter. The pattern for a Type 1B24 T/R Box is not as wide as the pattern for a Type 724 T/R Box.

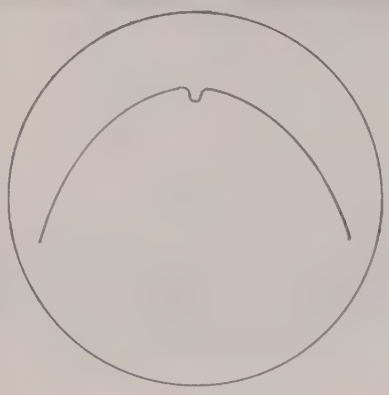
(8) Tune the R/T Box (anti T/R) for maximum amplitude of the resonant peak. In some cases, tuning the R/T Box has no effect. In others, it causes a broad dip to appear in the band-pass curve. The dip indicates that the action of the R/T Box is detrimental and it should be detuned to one side or the other. In a few cases, it will be found that the effect of the R/T Box is very pronounced.

(9) The amplitude of the band-pass pattern may be adjusted with the SPECTRUM AMPLITUDE control or with the MIXER AMPLIFIER control.

(10) The tuning procedure, outlined above, should be repeated each time a magnetron, crystal, T/R Box or R/T Box is replaced.

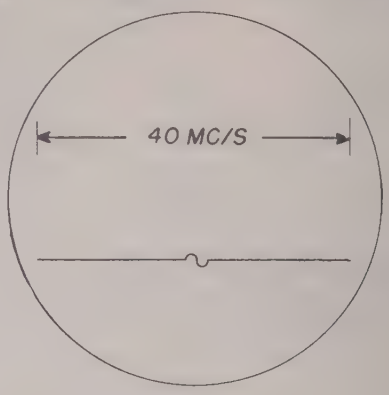
(11) Check the symmetry of the pattern. When the phone plug is removed from the Analyzer, the picture on the screen may be slightly distorted because of reflections back into the Analyzer. The symmetry of the pattern may be checked by turning the SPECTRUM AMPLITUDE control in a counterclockwise direction to eliminate the reflections.

(12) These reflections may be put to good use in checking the resonant frequencies of single components, such as frequency meters, T/R Boxes or echo boxes. A high Q component such as a frequency



a. MIXER POSITION

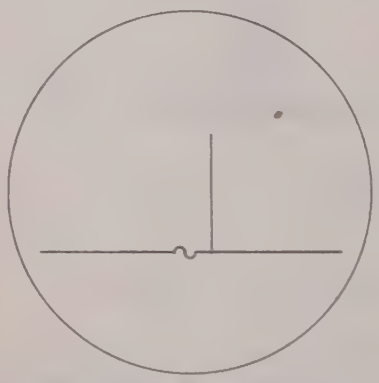
NO SIGNAL PRESENT EXCEPT THAT OF ANALYZER R-F OSCILLATOR



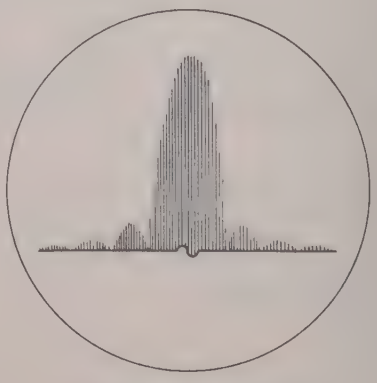
b. SPECTRUM OR SPECTRUM AMPLIFIED POSITION

NO OTHER SIGNAL PRESENT EXCEPT THAT OF ANALYZER R-F OSCILLATOR

NOTE: SPECTRUM WIDTH CONTROL SET TO JUST TAKE INDENTATIONS OFF THE END OF THE TRACER



c CW SIGNAL



d. PULSED SIGNAL

FREQUENCY SWEEP OF ANALYZER R-F OSCILLATOR IS WIDE ENOUGH TO INCLUDE A LARGE NUMBER OF SIDE BANDS

Figure 2-26. Representative CW and Pulsed Signals, SPECTRUM WIDTH Control Adjusted to Take Outside Indentations Off the Screen

meter or echo box should produce a pip similar to the pip of the frequency meter in the Analyzer when coupled to the Analyzer's wave-guide. Sometimes it may be necessary to move the component under test back and forth in front of the Analyzer wave-guide to obtain the best pip. Its frequency may be measured by setting the Analyzer frequency meter to the same frequency and tuning it until the two pips coincide. A representative pattern is shown in Fig. 2-24.

(13) It may be desirable to check the Analyzer frequency meter against a standard cavity by using the same procedure. A T/R Box produces a broad pip when held in front of the wave-guide. The SPECTRUM AMPLITUDE control must be set full clockwise for minimum attenuation during these tests.

9. SPECTRUM ANALYZER USED AS A SIGNAL GENERATOR.

a. The Analyzer may be used as a CW or FM (frequency-modulated) signal generator depending upon whether the SPECTRUM WIDTH control is set at either of its extreme positions. If it is set completely counterclockwise then the frequency modulation is at a minimum (about 3 mc/s) and the output is essentially a CW signal.

b. If the control is turned all the way clockwise then the frequency-modulation is maximum and the output is an FM source 40 or 50 mc/s wide, depend-

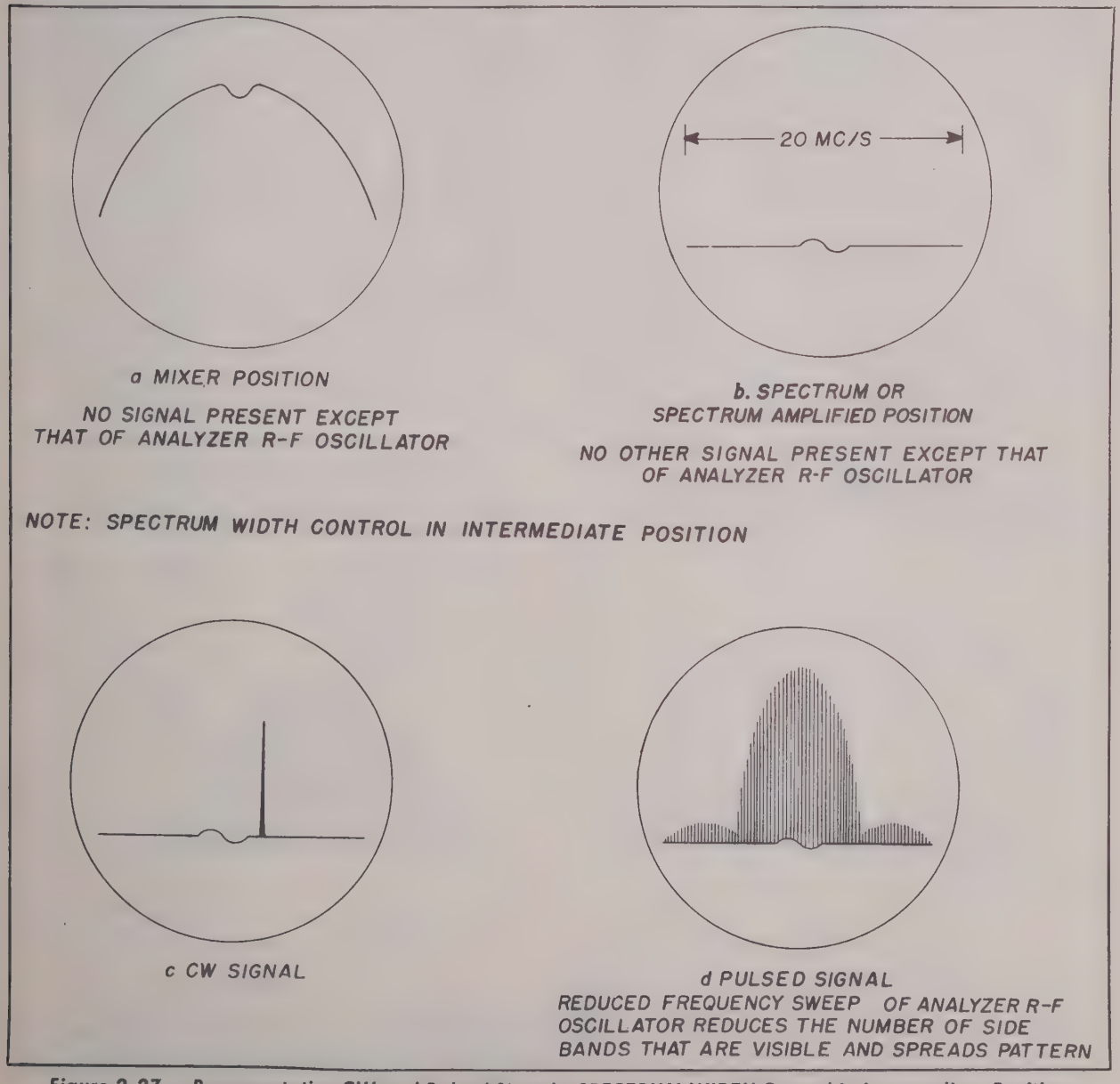

20 MC/S
a MIXER POSITION
NO SIGNAL PRESENT EXCEPT THAT OF ANALYZER R-F OSCILLATOR
b. SPECTRUM OR SPECTRUM AMPLIFIED POSITION
NO OTHER SIGNAL PRESENT EXCEPT THAT OF ANALYZER R-F OSCILLATOR
NOTE: SPECTRUM WIDTH CONTROL IN INTERMEDIATE POSITION
c CW SIGNAL
d PULSED SIGNAL
REDUCED FREQUENCY SWEEP OF ANALYZER R-F OSCILLATOR REDUCES THE NUMBER OF SIDE BANDS THAT ARE VISIBLE AND SPREADS PATTERN

Figure 2-27. Representative CW and Pulsed Signals, SPECTRUM WIDTH Control in Intermediate Position

ing upon the tube in the analyzer r-f oscillator. The output power ranges between 1 and 2 milli-watts.

10. USING THE SPECTRUM ANALYZER TO CHECK TEST SETS.

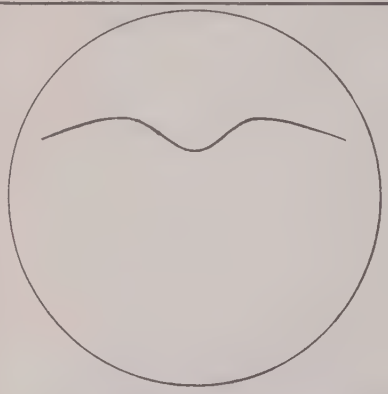
a. The Spectrum Analyzer may be used to check test sets. To check the output of CW or pulsed signal generators such as the TS-13/AP, or the TS-146/UP and TS-147/UP FM test sets, it is necessary to couple the set directly to the Spectrum Analyzer by means of the coaxial cable and the coaxial-to-wave-guide adapter.

b. Adjust the controls on the test set and observe, on the Analyzer, whether the proper spectrum appears on the screen. When switching from CW to pulse output on the TS-13/AP type of set, it will be necessary to decrease the amount of attenuation between the two sets before the pulsed spectrum will have sufficient amplitude to be seen.

c. A very good check of the FM signal generators can be made when they are delivering a CW output. That is, when no modulating voltage is being applied to the reflector of their oscillator tube. Figs. 2-25 to 2-28 show representative CW and pulsed signals for different settings of the SPECTRUM WIDTH Control.

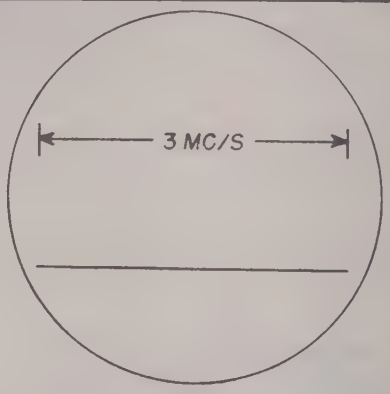
11. THE ANALYZER AS A TUBE CHECKER FOR TYPE 2K25 OR 723A/B TUBES.

a. The Spectrum Analyzer may be used to determine whether a 2K25 or a 723A/B tube is working properly by placing it in the socket of the analyzer r-f oscillator, turning the SELECTOR switch to the MIXER position and adjusting the controls until the characteristic hump, or mode curve appears on the



a MIXER POSITION

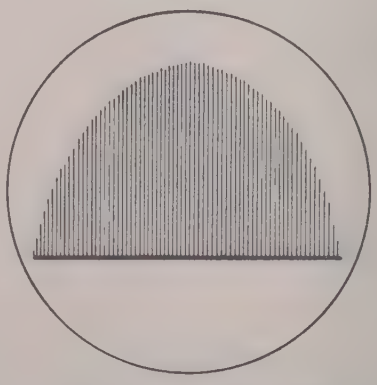
NO SIGNAL PRESENT EXCEPT THAT OF ANALYZER R-F OSCILLATOR



b. SPECTRUM OR SPECTRUM AMPLIFIED POSITION

NO OTHER SIGNAL PRESENT EXCEPT THAT OF ANALYZER R-F OSCILLATOR

c CW SIGNAL



d PULSED SIGNAL

MINIMUM FREQUENCY SWEEP OF ANALYZER R-F OSCILLATOR REMOVES SIDE BANDS AND SPREADS MAIN PORTION OF SPECTRUM ACROSS SCOPE SCREEN

Figure 2-28. Representative CW and Pulsed Signals, SPECTRUM WIDTH Control Full Counterclockwise

scope. Discontinuity in frequency, low power output, and non-oscillation at particular frequencies can be readily observed by this test.

b. The output of the tube may be checked roughly by comparing the amplitude of the pattern with the amplitude of the pattern of the analyzer r-f oscillator.

c. The mechanical tuning range may be checked by following it along with the frequency meter. The tube may be pre-set roughly to a given frequency by setting the FREQUENCY dial to the desired frequency and adjusting the mechanical tuning to place the frequency meter pip in the center of the hump or mode as it appears on the screen.

12. INTERPRETATION OF PATTERNS.

a. COMPOSITION OF A SPECTRUM.

(1) The factor of fundamental interest in the observation of the spectrum of a pulsed oscillator is the *envelope* of the pattern that appears on the scope. The individual lines are not particularly important.

(2) The spacing between the lines that appear to fill in the envelope of the spectrum, is due to the fact that the magnetron pulses are occurring at a frequency of 500 to 2000 cps. The sweep frequency of the scope may be as low as 10 cps. From 50 to 200 equally spaced pulses are thus *available* at this frequency for the formation of the pattern of the spectrum. When the sweep frequency is 30 cps from 17 to 67 pulses are *available.* The number of lines that can be seen depends upon the following factors:

(a) Analyzer r-f oscillator sweep time.

(b) The number of magnetron pulses occurring during the period that the sweep is visible.

(c) Whether the analyzer r-f oscillator oscillates over the entire visible sweep.

(d) The setting of the SPECTRUM AMPLITUDE control.

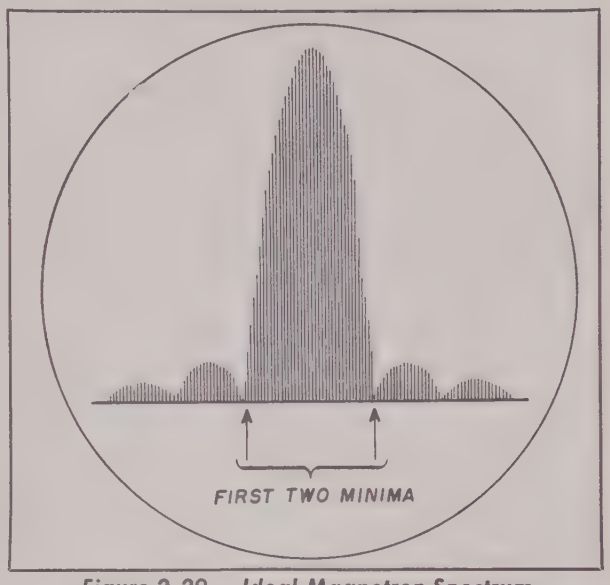
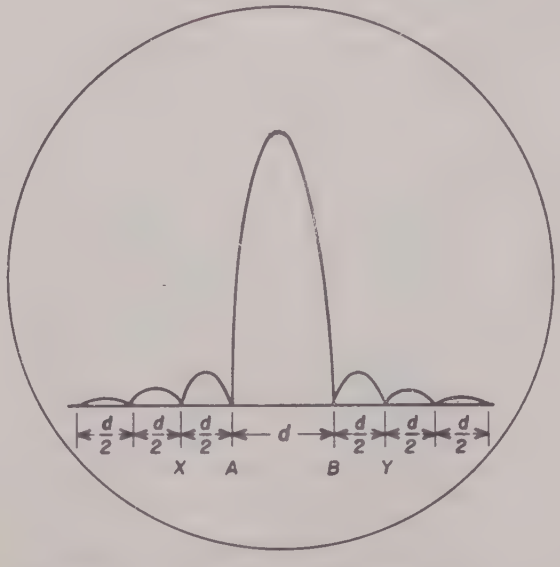


Figure 2-29. Ideal Magnetron Spectrum

(3) It would be ideal to have a very slow sweep frequency for the oscilloscope, but sweep frequencies below 10 cps produce a very objectionable flicker in the pattern. Therefore the present system represents a practical compromise.

PULSE LENGTH	d = DISTANCE IN MC/S BETWEEN FIRST TWO MINIMA
$\frac{1}{10}$ μS	20 MC/S
$\frac{1}{4}$ μS	8 MC/S
$\frac{1}{2}$ μS	4 MC/S
1 μS	2 MC/S
2 μS	1 MC/S
3 μS	$\frac{2}{3}$ MC/S
4 μS	$\frac{1}{2}$ MC/S
5 μS	$\frac{2}{5}$ MC/S



EXAMPLE: IF THE PULSE LENGTH IS 1 μS, THE FREQUENCY DIAL SHOULD SHOW 2 MC/S BETWEEN A & B OR 4 MC/S BETWEEN X & Y.

Figure 2-30. Relation Between Pulse Length and Spectrum Minima

(4) The SPECTRUM WIDTH control permits the spectrum to be spread out on the screen to give a clearer picture of the envelope even though the actual number of pulses available for the pattern has not been changed. The SWEEP FREQUENCY control also varies the number of pulses that are visible on the screen.

b. MAGNETRON SPECTRUM.

(1) When judging the merits of a magnetron spectrum, determine whether most of the magnetron power output is included in a frequency band that is equal to, or less than, the band-pass of the i-f amplifier in the radar receiver. If this is true, the radar set will operate at maximum efficiency and range. To determine the above, two observations are necessary.

(2) First determine whether the spectrum resembles closely the ideal spectrum shown in Fig. 2-29. The ratio between the amplitude of the main lobe and the first side lobes should be approximately 20 to 1. If it isn't, see Par. 12*c* of this section. If it does, determine whether the distance between the first two minima checks approximately, in frequency, with the frequencies and pulse lengths given in Fig. 2-30. These figures are ideal values but they compare favorably with those encountered in an actual system.

(3) A minimum may be defined as a point of lowest amplitude in the envelope of the spectrum. The final measurement of the distance between the first two minima is made with the frequency meter. In case of a narrow spectrum (long pulse length) it may be necessary to measure between several minima to get an accurate reading. The distance between any two adjacent minima is one-half of the distance between the first two minima.

(4) It is usually found that the band-pass of the receiver is slightly less than the distance between the first two minima for the shortest pulse to be used. The band-pass of a typical receiver for a .5 microsecond pulse is about 3 mc/s.

(5) The shape of the modulating pulse affects the shape of the spectrum. Up to this point only ideal spectra, produced by perfectly rectangular pulses, have been considered. In practice the keying pulses, applied to the magnetron, are not rectangular. The leading edge does not rise vertically, the top is not flat and the trailing edge droops off. All of these factors affect the output of the magnetron. The spectra of most magnetrons are altered by frequency and amplitude modulation. Since the shape of the pulse affects the frequency of the magnetron and its power output, it also affects the response and range of the radar receiver.

(6) Various pulse shapes produce characteristic spectra and a careful interpretation of imperfect spectra will often disclose the manner in which the pulse shape differs from the normal shape of the pulse.

(7) Consider a receiver with a 2-mc/s band-width to a one-microsecond pulse. Its response and range for a perfectly rectangular pulse may be assumed to be 100 per cent. If the received pulse has linear frequency modulation of 1, 2, and 3 mc/s per microsecond, the response of the receiver will be 90%, 65%, and 50% respectively. The range of the equipment will be reduced to 97%, 90%, and 78% for the values given. Some abnormal pulses and their characteristic spectra are shown in Fig. 2-31.

(8) An examination of this figure shows that frequency modulation is evidenced by a decided increase in the amplitude of the side lobes while amplitude modulation causes more side lobes to appear and if frequency modulation is present the spectrum loses its symmetrical shape. If two large peaks appear, they may be caused by the pulse shape or the transmitter is being pulled in frequency. Pulling or double moding frequently occurs when the transmitter voltage or the line voltage is out of adjustment. The representative photographs of magnetron spectra in Fig. 2-32 illustrate examples of the effects of various pulse shapes.

c. MAGNETRON ADJUSTMENTS.

(1) If the spectrum indicates pulling or if it does not indicate a pulse length and band-width that is reasonably close to the values in Fig. 2-30, the output voltage of the modulator may be adjusted. This is the only adjustment that can be made on most equipments and it seems to be most sensitive on the longer pulse lengths. A satisfactory spectrum may have the side lobes on one side much lower in amplitude than those on the other side. This is all right if the main lobe is of the right width and has most of the energy.

(2) If an adjustment of the output voltage of the modulator does not produce a good spectrum, tests must be made to determine the cause of the trouble. Test the modulator or pulse transformers, the magnetron tube, and the wave-guide that is associated with the magnetron.

d. POWER MEASUREMENTS.

(1) The height of the pattern on the Analyzer scope corresponds to the power output of a signal. If one pulse in a spectrum is half as high as another pulse, the lower pulse has only half of the power in the other pulse. A magnetron spectrum should appear like the sketch of the ideal power spectrum for a pulsed magnetron shown in Fig. 2-29.

13. TUNING RADAR EQUIPMENT.

a. GENERAL.

(1) The Spectrum Analyzer is useful when tuning transmitter-converters in radar equipment. Since the AN/APS-6 series is representative of equipment which operates in the range covered by the Analyzer, its tuning procedures can be readily adapted to other equipments.

Note

When using the Analyzer to tune radar equipment be sure that no other equipment is operating where it can be picked up by the

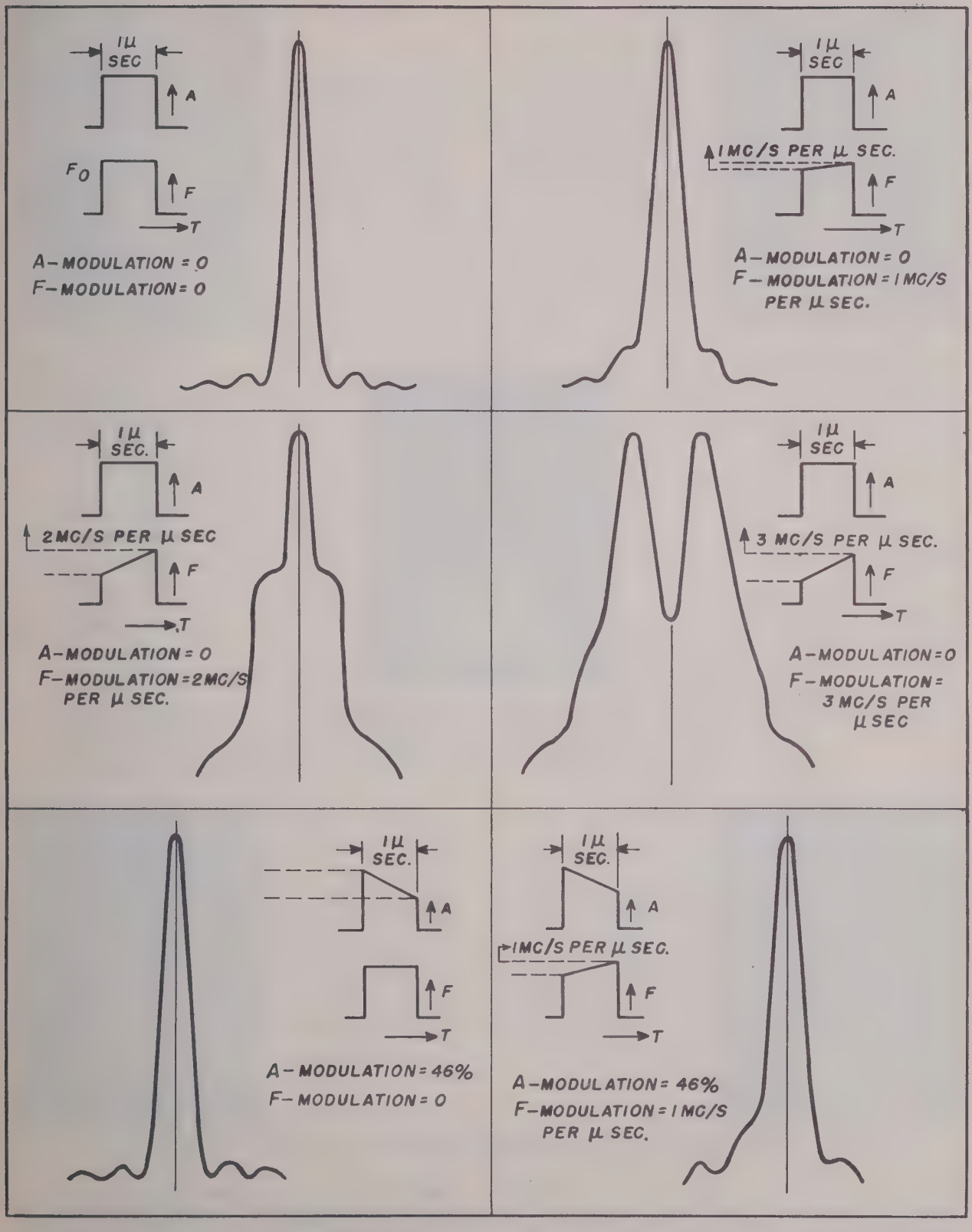
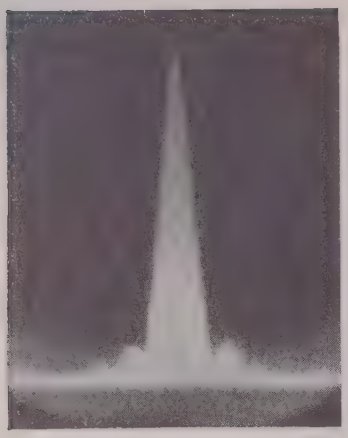
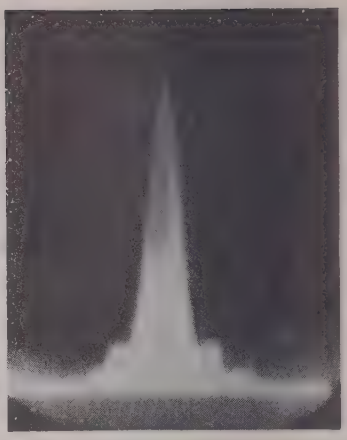


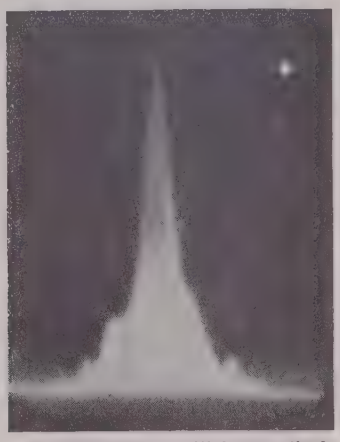
Figure 2-31. Representative Magnetron Spectra



1. Good spectrum. Small side bands with distinct minima, indicating zero frequency and amplitude modulation. Receiver response 100 per cent.

2. Fair spectrum. Frequency modulation of one megacycle per second per second shifts pattern to left and increases side band amplitude. Receiver response 88 per cent.





3. Poor spectrum. Slight amplitude modulation evidenced by disappearance of first minimum on right and appearance of additional side bands. Frequency modulation is one megacycle per second per second.

4. Very poor spectrum. Frequency modulation is two megacycles per second per second. Pattern shows marked shift to left and increased side band amplitude. Receiver response 68 per cent

5. Bad spectrum. Forty-five per cent of amplitude modulation evidenced by additional peaks and unsymmetrical shape. Frequency modulation of three megacycles per second per second causes appearance of two large peaks three megacycles apart. Receiver response 45 per cent

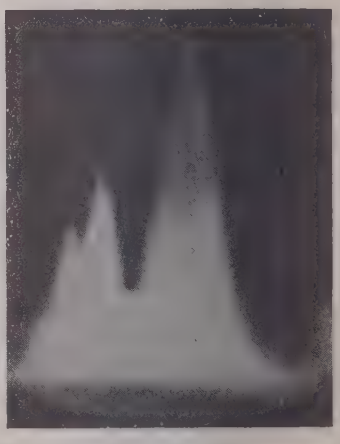


Figure 2-32. Effects of Frequency and Amplitude Modulation on the Shape of Magnetron Spectra

These spectra are produced by a one-microsecond pulse. Frequency increases from left to right and the width of the screen is 9.5 megacycles. Receiver response is based on the performance of a receiver with a two-megacycle bandwidth.

Analyzer. Interference from other equipments will produce spurious spectrum patterns.

b. TUNING THE AN/APS-6.

(1) The following is a brief description of the method recommended for tuning the AN/APS-6. This description is primarily concerned with the Analyzer. For detailed instructions concerning the AN/APS-6 equipment as a whole, refer to Maintenance Instructions CO-AN08-30APS6-2.

(2) Turn the equipment on and operate it for 15 minutes to allow the magnetron to reach a stable operating temperature.

(3) Couple the Analyzer to the Scanner as shown in Fig. 2-9. Set the equipment on the 25-mile range.

(4) Adjust the output voltage of the modulator to produce a good spectrum as outlined in Par. 12 of this section.

(5) Measure the frequency of the magnetron as described in Par. 6*b* of this section, placing the frequency meter half way between the right and left patterns. Do not change frequency meter during the remainder of this operation.

(6) *Turn the AN/APS-6 completely off.* See that the OPERATE-STANDBY switch is in the STANDBY position, and that cable P between the Transmitter-Converter and the Modulator is disconnected at the modulator.

(7) Couple the Transmitter-Converter directly to the Analyzer as shown in Fig. 2-22.

WARNING

DO NOT OPERATE THE MAGNETRON WHILE THE ANALYZER IS DIRECTLY CONNECTED. TO DO SO WILL CAUSE SERIOUS DAMAGE TO THE ANALYZER.

(8) Place the RADAR-BEACON switch in the RADAR position and check the oscillator relay to see that it is in the radar position.

(9) Energize the radar shutter relay with 24 volts to keep it from blocking the wave-guide to the mixer during the tuning operation.

(10) Tune the T/R Box and the R/T Box (anti-T/R) as outlined in Par. 8 of this section.

(11) Turn the equipment on. *Be certain that the OPERATE-STANDBY switch is in the STANDBY position.*

(12) Disconnect the Analyzer from the Transmitter-Converter.

(13) Turn the AFC on and remove the AFC crystal cable or one of the AFC tubes. *Do not remove either V-315 or V-316.*

(14) Set up the Analyzer to pick up the radar local oscillator. This oscillator is the one closest to the center of the Transmitter-Converter. Use the method as shown in Fig. 2-11.

(15) Plug a meter, with a three-ma. range, into the crystal current jack on the Transmitter-Converter.

(16) Set the TUNING control to the mid-scale position on MANUAL.

(17) Note the dial reading of the magnetron frequency and adjust the radar local oscillator's mechanical and electrical tuning controls to obtain the results outlined in Par. 7*b* of this section. Leave the frequency meter set on the local oscillator frequency.

(18) Adjust the crystal current screw to obtain the proper amplitude of crystal current as indicated on the meter. This current must not exceed one ma. When the oscillator is tuned with the TUNING control in its MANUAL position, only one mode should be obtained.

(19) Replace the AFC crystal cable, or tube, and note whether the frequency meter pip, as previously set, is centered on the local oscillator spectrum. If it is not, adjust the AFC discriminator's screwdriver adjustment until the pattern centers on the frequency meter pip.

(20) Place the beacon local oscillator in operation by turning the RADAR-BEACON switch to BEACON.

(21) Place the TUNING control in the MANUAL position.

(22) Couple the Analyzer to the beacon local oscillator. The beacon local oscillator is the one farthest from the center of the Transmitter-Converter. Use the method shown in Fig. 2-11.

(23) Tune the beacon local oscillator in the same manner outlined above and in accordance with Pars. 7*b*. and 7*c*. of this section.

c. TUNING THE AN/APS-6A.

(1) The following procedure is recommended for tuning the AN/APS-6A.

(2) Turn the equipment on in accordance with the procedure outlined in its instruction manual. Allow it to operate for 15 minutes to insure that the magnetron has reached a stable operating temperature.

(3) Couple the Analyzer to the Scanner as shown in Fig. 2-9 and adjust the output voltage of the modulator to produce a good spectrum as outlined in Par. 12 of this section. Refer to the instruction manual of the AN/APS-6A for the proper procedure involved in this step.

(4) Measure the frequency of the magnetron as outlined in Par. 6*c*. of this section.

(5) *Turn the AN/APS-6A completely off.* See that the OPERATE-STANDBY switch is in the STANDBY position. Disconnect cable P at the Modulator.

(6) Couple the Analyzer directly to the Transmitter-Converter RT-32/APS-6A as shown in Fig. 2-22.

WARNING

DO NOT OPERATE THE MAGNETRON WHILE THE ANALYZER IS DIRECTLY CONNECTED. TO DO SO WILL CAUSE SERIOUS DAMAGE TO THE ANALYZER.

(7) Tune the T/R and R/T Boxes as outlined in Par. 8 of this section.

(8) Disconnect the Analyzer from the Transmitter-Converter.

(9) Set up the Analyzer to pick up the radar local oscillator. See Fig. 2-11 and Par. 7*b*. of this section.

(10) Turn the AN/APS-6A on, keeping the OPERATE-STANDBY switch in the STANDBY position.

(11) Check the RADAR-BEACON switch on the Control Unit to see that it is in the RADAR position and check the oscillator relay in the Junction Box to see that it has placed the radar local oscillator in operation.

(12) Plug a milliammeter with a one-ma. range into the crystal current jack.

(13) Place the TUNING control at the mid-position on the MANUAL scale.

(14) Turn the AFC on and remove one of the AFC tubes on the i-f strip in the Receiver Amplifier. *Do not remove either V-614 or V-615.*

(15) Adjust the radar local oscillator tuning controls to obtain the results outlined in Par. 7*b*. of this section. Do not disturb the position of the frequency meter pip after the final adjustment has been made. The meter should indicate maximum crystal current at this point.

(16) Replace the AFC crystal cable or tube and adjust the AFC screwdriver adjustment until the radar local oscillator pattern centers over the frequency meter pip.

(17) Turn the RADAR-BEACON switch to BEACON.

(18) Place the TUNING control in the MANUAL position. Set it in the same mid-scale position that was used for the radar local oscillator.

(19) Couple the Analyzer to the beacon local oscillator. The beacon local oscillator is the upper of the two local oscillators and is adjusted from the side. Use the method shown in Fig. 2-11.

(20) Tune the beacon local oscillator with the mechanical adjustment until the results outlined in Pars. 7*b*. and 7*c*. of this section have been obtained.

SECTION III
THEORY OF OPERATION

1. GENERAL.

a. FUNCTION OF THE SPECTRUM ANALYZER.

(1) The TS-148/UP Spectrum Analyzer is a test instrument that displays, on an oscilloscope, a pattern representative of the distribution of energy among the various frequencies in the output of a pulsed oscillator. As is explained in paragraph 1*b.*, below, the spectrum of a pulsed oscillator consists of energy distributed among many different frequencies. The Spectrum Analyzer presents, on an oscilloscope display, a pattern in which the relative amplitudes of many of the various frequencies of the spectrum are plotted on the vertical, or Y-axis, while the frequencies themselves are plotted on the horizontal, or X-axis, of the tube. The overall pattern of this display may be interpreted so as to indicate the proportion of power present at the various frequencies within the spectrum.

b. FORMATION OF A SPECTRUM.

(1) A common conception of the output of a pulsed oscillator is a single frequency which is turned on and off for periods of standard duration, similar to the output of a conventional c-w telegraph transmitter. The output of the radar oscillator does not consist of a fundamental frequency that is turned on and off but must be considered as a fundamental frequency that is modulated by the waveform of the pulse.

(2) It must be understood that any fundamental frequency, when modulated by another frequency, will produce a fundamental frequency with sideband frequencies which are collectively called a spectrum. In other words, *the output will appear on more than one frequency.* The distribution of the power on these frequencies is a function of the modulation and is called a spectrum. Normally, modulation is plotted on an amplitude and time basis, as shown in Part 1 of Figure 3-1. Part 2 of this figure shows the spectrum produced by a fundamental frequency when it is modulated by frequencies Fp_1, Fp_2 and Fp_3.

(3) Assume F to be the fundamental frequency or an oscillator. A waveform of this fundamental frequency, plotted as amplitude against time, is shown in Ⓐ in Part 1 of Figure 3-1. The number of periods $\left(\frac{1}{F}\right)$ occurring within one second determines the frequency of the oscillation. The amplitude is represented as proportional to the distance between the negative and positive peak of one cycle of oscillation.

(4) In a spectrum pattern, this same frequency and amplitude would be represented as F in Part 2 of Figure 3-1. Points along the horizontal coordinate represent frequency, which increases from left to right, while distances along the vertical coordinate above the baseline represent amplitude. Parts 1 and 2 of Figure 3-1 represent two methods of diagramming the results of amplitude-modulating a carrier frequency.

(5) Assume Fp_1 is a modulation frequency applied to the fundamental frequency, *F*. This is normally represented on an amplitude versus time basis as Ⓑ in Part 1 of Figure 3-1. This same type of modulation is represented by *two* lines on the spectrum pattern. These lines are marked $F+Fp_1$ and $F-Fp_1$ in Part 2 of the figure. The reason for this is that the modulated wave actually represents the results of *heterodyning,* two different frequencies. In other words, the modulation produces the same envelope that would be produced by heterodyning the side band and fundamental frequencies shown in Fig. 3-1. It follows that these frequencies are effectively present in the modulated envelope and can be detected by suitable receivers. The two frequencies producing the portion of the spectrum previously mentioned are *F* and Fp_1 the fundamental and modulating frequency, respectively. The result is the production of two additional frequencies as stated previously. One of these is the *sum* of the two frequencies, while the other is the *difference* between them. The amplitudes of the new frequencies are each half of the amplitude of the modulating frequency.

(6) Assume also, that a second harmonic of the modulating frequency also exists. This is usually of a lower degree of amplitude than the fundamental of the modulating frequency. Call this frequency Fp_2. Another set of waves is developed, as shown in Parts 1 and 2 in Fig. 3-1. The amplitude of the two new frequencies created is less than that created by Fp_1.

(7) Additional modulating frequencies will produce additional side band frequencies. Since these frequencies are normally present in a harmonic relationship, the net result is a number of different frequencies above and below the carrier. The difference between any two adjacent frequencies is equal to the fundamental modulating frequency.

c. SPECTRUM OF A PULSED OSCILLATOR.

(1) Usually a pulse modulated oscillator is pulsed by the application of a rectangular wave of voltage to an oscillator circuit. A narrow rectangular wave of voltage contains an exceedingly wide range of harmonics, including harmonics of a very high order. A rectangular wave of voltage can be considered as a summation of a sine wave funda-

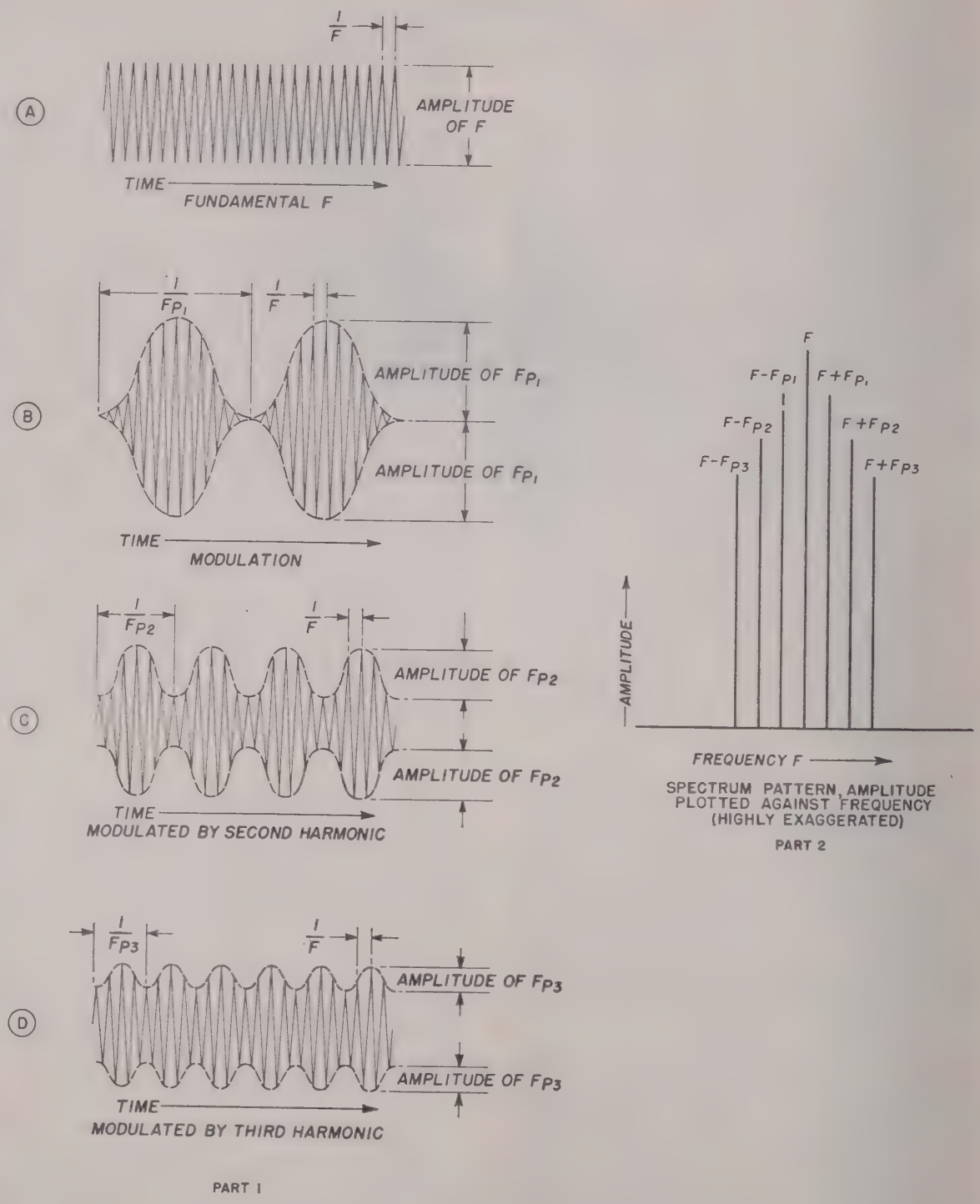


Figure 3-1. Comparison of a Plot of Amplitude vs. Time With a Plot of Amplitude Against Frequency

mental of the repetition frequency plus an infinite number of sine wave harmonics. Consequently a pulsed oscillator may be assumed to be an oscillator modulated by a modulation frequency which is exceedingly rich in harmonics. A pulsed oscillator, turned on and off as in Figure 3-2, produces an output similar to that which would be produced by a sine wave repetition frequency and its harmonics phased so that their summation would produce a waveform similar to the modulating pulses.

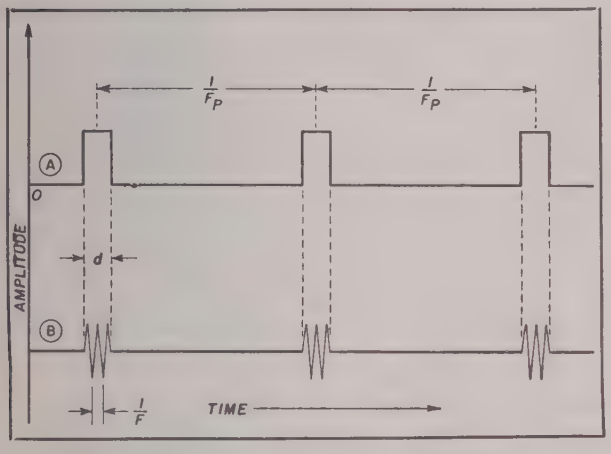


Figure 3-2. Output of Pulsed Oscillator

(2) In Figure 3-2, the pulse frequency and the basic frequency of the pulsed oscillator are shown on a time and amplitude graph. From this, it might appear that the output was simply a pure c-w wave, of constant amplitude and frequency turned on for brief intervals of time. This cannot be true because of the presence of the modulation frequency *Fp* and the very large number of harmonics of the modulation frequency, Fp_1, Fp_2, etc. The fundamental modulation frequency and its many harmonics may be considered to modulate the oscillator to produce a fundamental frequency with many side bands. The net result is a spectrum such as was developed in Figure 3-1, except that it is extended to a very large number of frequencies above and below the fundamental frequency. Such a spectrum is shown in Part Ⓐ of Figure 3-3. The pulse frequency that produces this spectrum is shown in Part Ⓑ of Figure 3-3. The output of the oscillator consists of an infinite number of lines representing different frequencies. However, due to the harmonic relationship between the modulation frequency and its harmonics, these lines will always be separated by a distance on the base line that is equal to the fundamental modulation frequency, Fp_1.

(3) From the above discussion, it may be deduced that the amplitude versus frequency plot, will provide an envelope which is of value in estimating the power distribution in the output of a pulsed oscillator. This spectrum, as plotted on the Spectrum Analyzer is a power spectrum due to the square law characteristics of the Analyzer's detector. The true power spectrum, which represents the voltage, (or amplitude) squared (E^2) is shown as Part Ⓓ of Figure 3-3. This power spectrum emphasizes even more forcefully than the voltage spectrum in Part Ⓐ in the same figure, the importance of confining the majority of the power at the fundamental frequency of the pulsed oscillator. Actually the Spectrum Analyzer pattern, as shown in Figure 3-3, Part Ⓒ represents only a "sampling" of the spectrums. Each of the separated lines seen on the spectrum represents a section of the spectrum. The explanation of this pattern is given later in this section.

(4) The actual power amplitude of any frequency may be computed by mathematics using Fourier's formula for harmonic analysis. This formula may be found in any standard calculus book. Part Ⓓ of Figure 3-3 effectively shows the results of this calculation for a standard oscillator when pulsed by a standard pulsing circuit. The Spectrum Analyzer, by providing a power spectrum, provides an effective means of approximating the power components of the spectrum. It can be of great value in tuning up a pulsed oscillator so as to provide the greatest range of power output in the band-pass circuits of the receiver.

d. PRACTICAL ANALYSIS OF A SPECTRUM.

(1) The following analysis of a spectrum assumes a fundamental oscillator frequency of 9,000 mc/s (or 9,000,000 kc/s) and a pulse repetition frequency of 2,000 cps (or 2 kc/s). Two sidebands would be produced. One of these would be a frequency representing the fundamental plus the modulation frequency (9,000,002 kc/s) while the other would be a frequency equivalent to the difference (8,999,998 kc/s) between the two frequencies. Therefore, if this were the *only* frequency modulating the fundamental frequency, the output would appear on *three* frequencies, namely, the fundamental frequency, a frequency equal to the fundamental plus 2 kc/s, and the fundamental frequency minus 2 kc/s. The difference between any two adjacent frequencies would be 2 kc/s, or the repetition frequency.

(2) The second harmonic of the pulse frequency is 4 kc/s. The second harmonic produces two additional frequencies which are 4 kc/s above and 4 kc/s below the fundamental frequency of the oscillator. The third harmonic produces two more frequencies which are 6 kc/s above and below the oscillator frequency. It can be seen that all of these frequencies are 2 kc/s apart, which is the fundamental pulsing frequency. Consequently the spectrum produced by a pulsed oscillator may be said to be formed of the amplitude of various frequencies which are separated on the baseline by a distance that represents the frequency of the repetition rate.

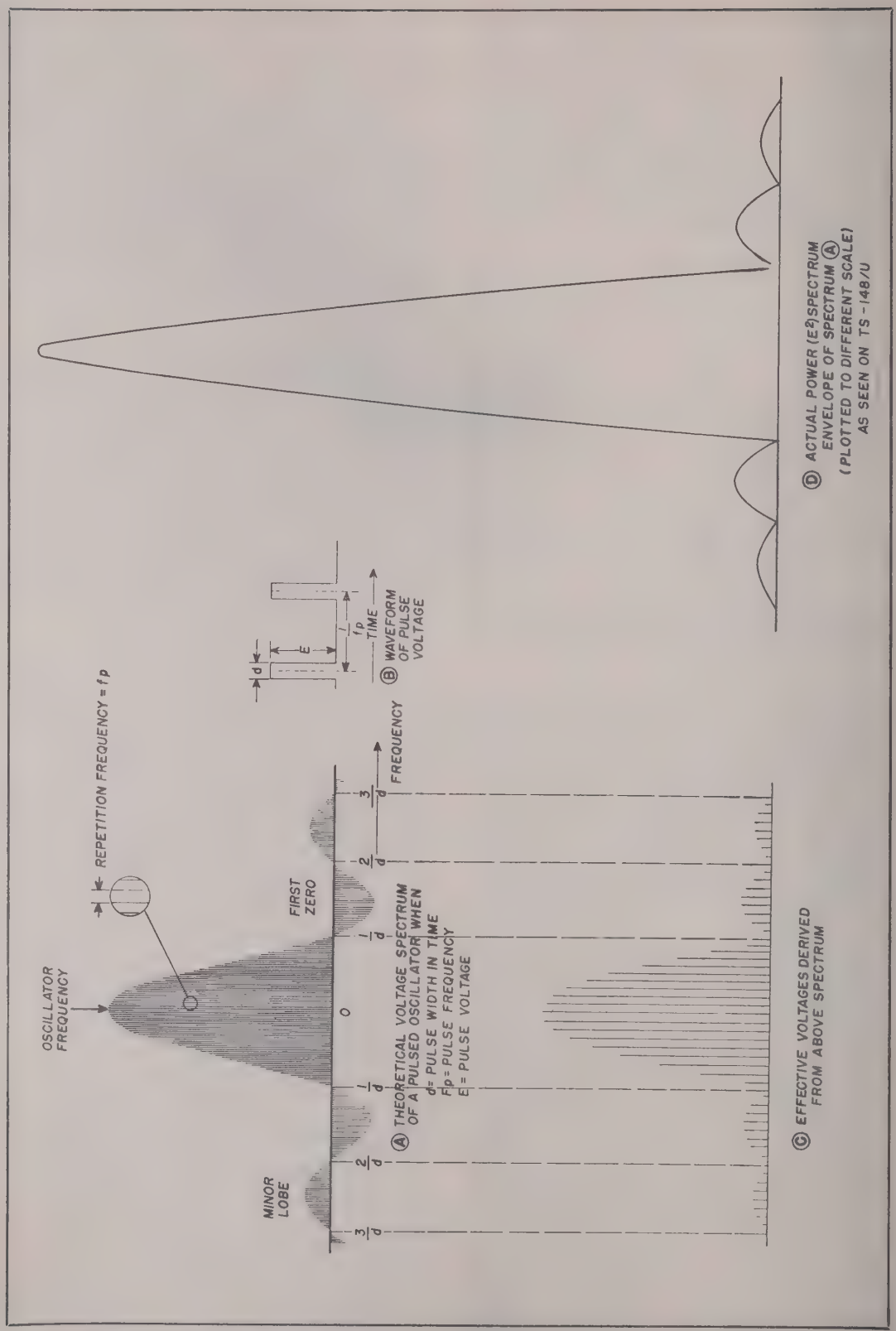


Figure 3-3. Relationship Between a Voltage Spectrum and a Power Spectrum

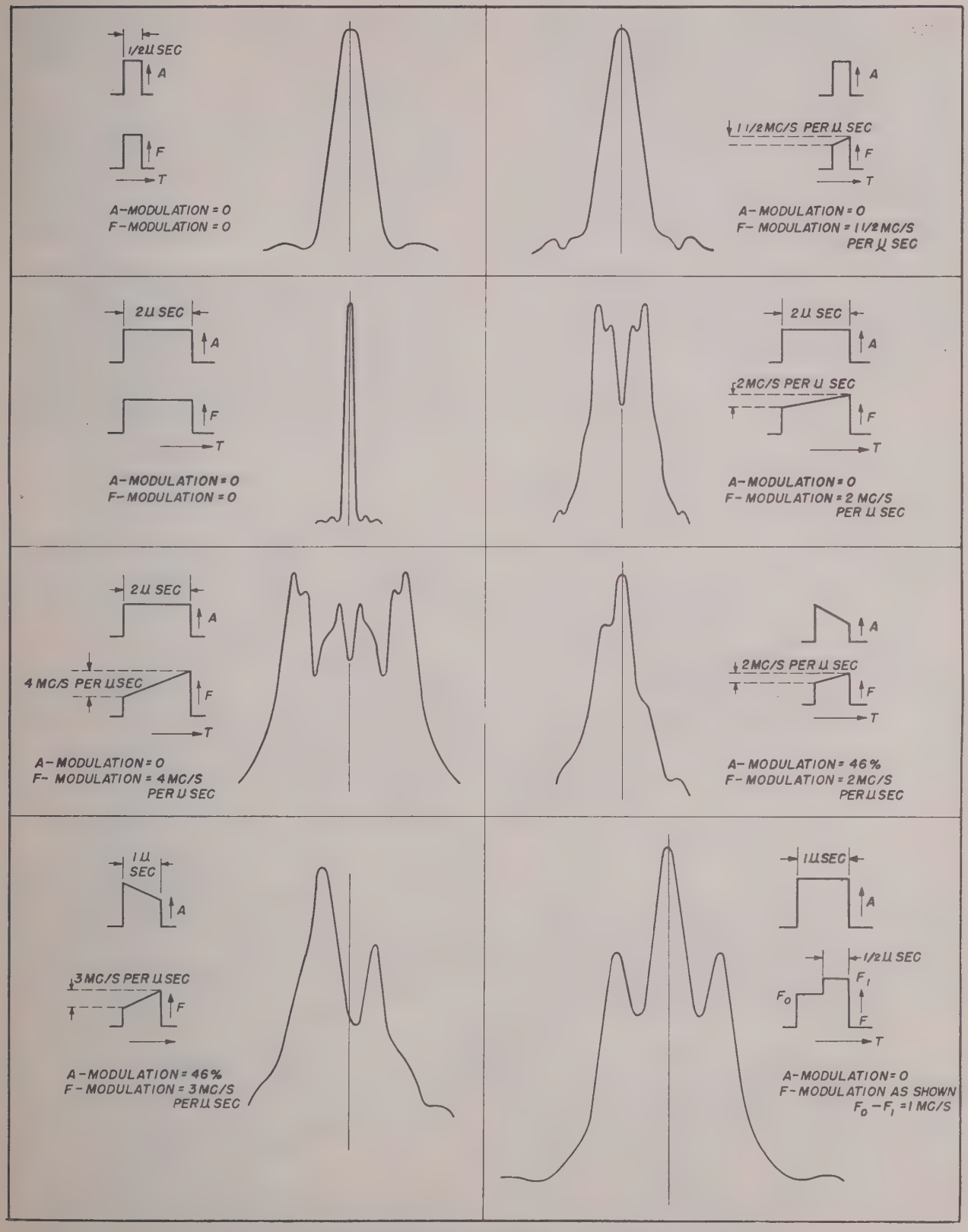


Figure 3-4. Spectra Showing the Effect of Frequency Modulation

(3) This condition obtains only when a *true* rectangular pulse is applied to the oscillator. In actual practice, the pulse applied to the oscillator is not a true rectangular wave. The flat top usually has a negative or positive slope. The trailing edge is not vertical, but droops. In addition, certain transients are present in the pulse. These transients have a harmonic "family" of frequencies of their own, all of which are present in the pulse. These additional frequencies of the rectangular wave cause both amplitude and frequency modulation of the oscillator. The effect of amplitude modulation is to increase the number of side bands in the spectrum, while the effect of frequency modulation is to increase the amplitude of the sidelobes, since the actual fundamental frequency of the oscillator is shifted back and forth between points on each side of its true fundamental frequency.

(4) Certain spectra, showing the effects of frequency modulation are shown in Fig. 3-4, and the causes of unusual spectra are described with the various parts of this figure. Some general conclusions may be drawn from the spectra shown in these figures. These conclusions are as follows:

(a) The width of the center lobe of an ideal spectrum should not greatly exceed the bandwidth of the receiving section of the radar set. Otherwise power will be wasted which will result in a reduced output from the receiver.

(b) A spectrum without deep minimum points adjacent to the main lobe indicates frequency modulation of the oscillator.

(c) If two distinct peaks are observed on the spectrum, the transmitting oscillator is operating in two modes, or is being pulled in frequency by some external force, such as a poorly matched rotating antenna or fluctuating voltages.

(d) The frequency difference between two peaks indicates the amount of frequency pulling, or scatter-

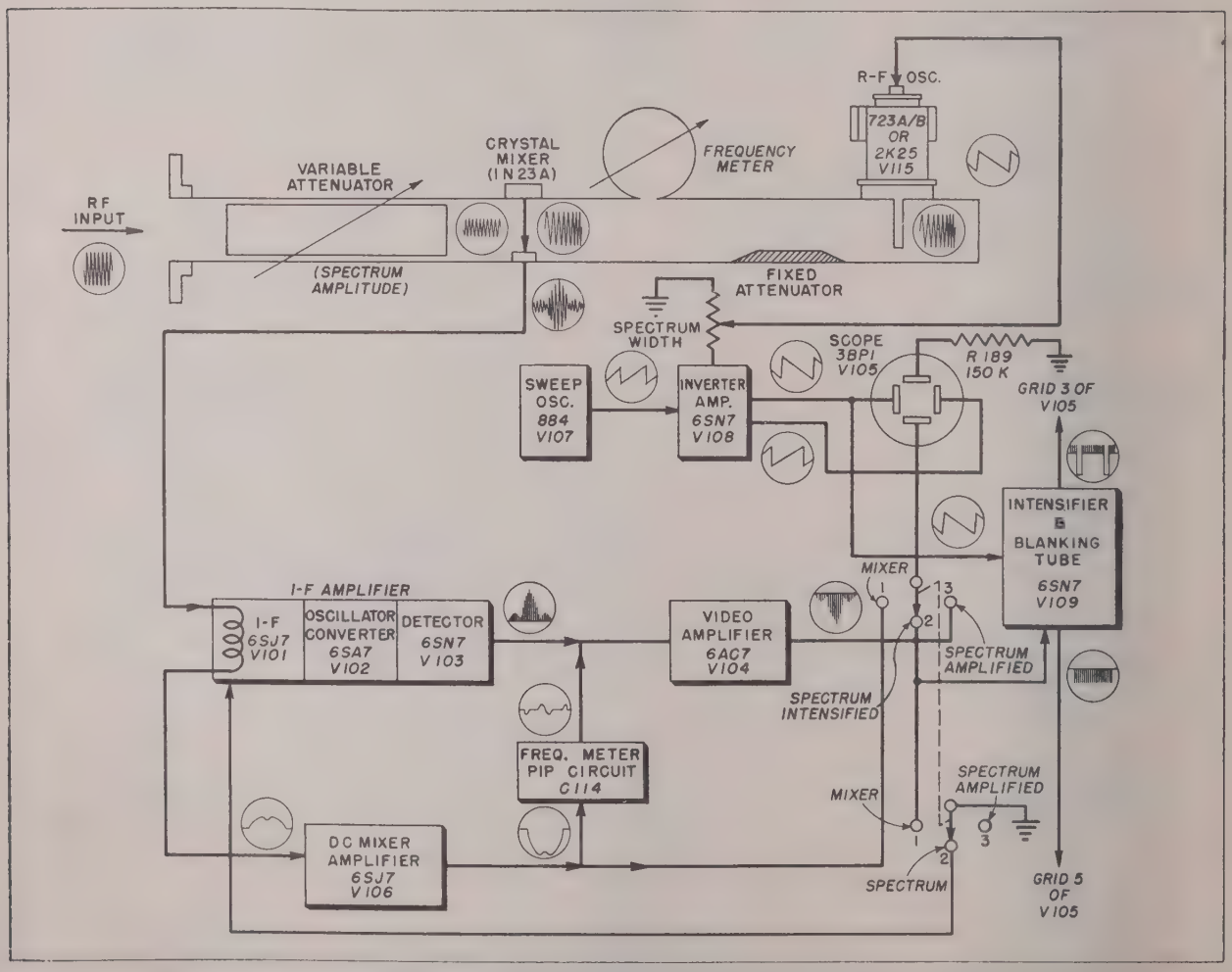


Figure 3-5. Spectrum Analyzer, Block Diagram

ing. The height of each of these peaks represents the proportional amount of power at the frequency of each of the peaks.

(e) The width of the modulating pulse may be determined by measuring the distance between the minima on each side of the main portion of a good spectrum. The measurement of pulse width and the conclusions which may be drawn are described in Section II, Par. 12*b*.

2. BLOCK DIAGRAM.

a. GENERAL.

(1) The TS-148/UP Spectrum Analyzer consists of a superheterodyne receiver with a frequency-modulated r-f oscillator. The analyzer r-f oscillator is modulated with a sawtooth voltage. As the frequency of the analyzer r-f oscillator increases, it beats with the incoming signal to produce an i-f signal for various frequency components present in the spectrum of the received r-f signal. These signals are presented on a cathode ray oscilloscope to produce the patterns described in Par. 1 of this section.

b. MAJOR OPERATING CIRCUITS.

(1) The block diagram in Fig. 3-5 shows the basic circuits of the Spectrum Analyzer. A clear understanding of each block or circuit will enable the reader to follow more easily the detailed theory of operation.

(2) ATTENUATOR.

(a) The attenuator which controls the spectrum amplitude consists of two carbonized resistance cards inserted in the r-f input end of the wave-guide. Varying the contour of these cards varies the degree of attenuation. Maximum attenuation is obtained when the cards are flexed together in the center of the wave-guide. The attenuator controls the amplitude of the r-f signal entering the Analyzer, or leaving the Analyzer.

(3) ANALYZER R-F OSCILLATOR.

(a) The analyzer r-f oscillator is a reflex type velocity-modulated tube. It is frequency-modulated by a portion of the sweep voltage that is applied to the oscilloscope. Modulating voltage is obtained from the output of the sweep amplifier, and it provides a frequency swing of 40 to 50 mc/s. Its output is matched to the load by the fixed resistance card (E-101C) in the wave guide.

(4) CRYSTAL MIXER.

(a) Farther down the wave-guide is a fixed crystal. The incoming r-f signal and the output of the analyzer r-f oscillator are mixed at the crystal. The output is applied to the input circuit of the tuned 22.5-mc/s i-f amplifier to produce the intermediate frequency of 22.5 mc/s.

(5) FREQUENCY METER.

(a) The frequency meter is mounted on the wave-guide at a point between the crystal mixer and the analyzer r-f oscillator. The frequency meter is an absorption type meter and it consists of a cavity with dimensions that can be varied by a front-panel control. Each time the frequency of the analyzer r-f oscillator passes through the resonant frequency of the frequency meter, the frequency meter absorbs some r-f power. This causes a sharp decrease in the amplitude of the output of the analyzer r-f oscillator that is applied to the crystal. This change in amplitude is caused to appear on the scope as a sharp pip that is used as a frequency marker. A dip occurs when the frequency of the r-f input coincides with the frequency of the frequency meter.

(6) FIRST I-F AMPLIFIER.

(a) The output of the crystal mixer is applied to the input circuit of the 22.5-mc/s intermediate frequency amplifier. This amplifier is resonant at 22.5 mc/s. The output of this stage is applied to the oscilator-converter.

(7) OSCILLATOR-CONVERTER.

(a) This stage is used to obtain the narrow band-width of 50 kc/s. It contains a local oscillator operating at a frequency of 19.5 mc/s. The intermediate frequency is changed to three megacycles in this stage by beating the 19.5-mc/s frequency against the 22.5-mc/s frequency. The sharply tuned plate circuit of this stage produces the narrow band-pass characteristic that is required. The output is applied to the detector stage.

(8) DETECTOR-VOLTAGE REGULATOR.

(a) The output of V-102 is connected to one of the grids of the double-triode V-103. The detector section functions as an infinite-input-impedance detector. The rectified output of the detector is taken from the cathode of the tube and coupled to the grid of the video amplifier V-104. The other section of V-103 is a voltage regulator. It controls the screen voltage of the video amplifier.

(9) VIDEO AMPLIFIER AND FREQUENCY METER PIP CIRCUIT.

(a) This stage has two input voltages. One is the output of the detector and the other is the frequency meter pip obtained from the d-c amplifier through a differentiating circuit. The output of the video amplifier is coupled to the vertical deflecting plates of the oscilloscope tube. A portion of the video output is used to trigger the intensifying section of V-109.

(10) D-C MIXER AMPLIFIER.

(a) When the SELECTOR switch is in MIXER position 1, in Fig. 3-5, the d-c mixer amplifier amplifies the output of the crystal mixer and applies it through the SELECTOR switch to the vertical plates of the scope for test purposes. A jack allows the crystal mixer of a radar set to be connected to the input circuit of this stage instead of the crystal mixer of the Analyzer. When the SELECTOR switch is in either of its other two positions, the frequency meter pip and the

pips caused by the beginning and end of the frequency sweep of the analyzer r-f oscillator are amplified by this tube and coupled to the video amplifier. The SPECTRUM WIDTH control is normally set so that only the frequency meter pip appears.

(11) SWEEP OSCILLATOR.

(a) The sweep oscillator V-107 is a gas-tube type relaxation oscillator that generates a sawtooth output at frequencies between 10 and 30 cps. The sweep oscillator may be locked in with the ripple voltage in the high voltage power supply. The output of the sweep oscillator is used to drive the sweep amplifier-inverter.

(12) SWEEP AMPLIFIER-INVERTER.

(a) The sweep amplifier-inverter V-108 provides push-pull deflection voltages for the horizontal plates of the cathode-ray tube. It also supplies modulating voltage to the analyzer r-f oscillator and trigger voltage for the blanking section of V-109.

(13) INTENSIFIER-BLANKING TUBE.

(a) The input voltage from the first section of the sweep amplifier-inverter V-108, is differentiated and used to trigger the first section of V-109. The output of this section is applied as a blanking voltage for the return trace that would otherwise appear on the scope screen.

(b) When the SELECTOR switch is in either of the SPECTRUM positions the video signal is applied to the grid of the second section of V-109. The output from V-109 that is produced by this signal is coupled as intensifying voltage to the first or intensifying grid of the cathode-ray tube.

3. DETAILED FUNCTIONING OF THE CIRCUITS.

a. ATTENUATOR.

(1) When an r-f signal from an outside source enters the wave-guide it must pass the variable attenuator to reach the crystal mixer. The attenuator is shown in Fig. 3-6. The attenuator controls the amount of signal voltage that reaches the mixer and therefore controls the amplitude of the pattern on the screen. The control knob is marked SPECTRUM AMPLITUDE.

(2) The variable attenuator consists of two flat resistance strips which lie flat against the narrow sides of the guide. See Figs. 3-6 and 3-7. The ends are fastened down but still allow the strips to slide slightly as they are bowed into the center of the guide by means of the adjusting screw mechanism. As these strips with their carbonized resistance coating are moved in from the sides of the guide, they intersect more and more r-f energy (E-lines) and thus cause the attenuation to increase. The range of the attenuator is from 3 db to 70 db.

(3) The attenuator may be disassembled by loosening the two screws on the back plastic part and unscrewing the right and left hand plastic adjusting screws. The strips can be removed by poking a suitable object through the center hole, against the strip. They are reassembled in a similar manner.

b. ANALYZER R-F OSCILLATOR.

(1) The analyzer r-f oscillator is a Type 2K25 or

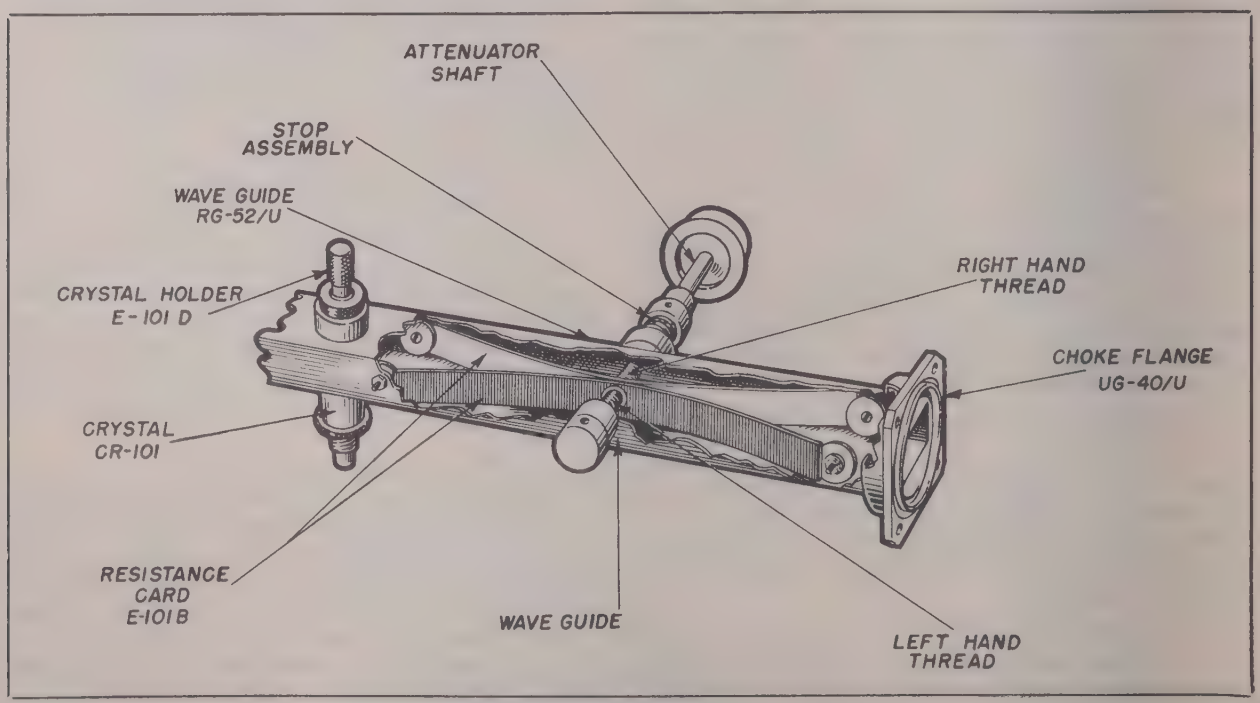


Figure 3-6. Variable Attenuator

723A/B Shepard-Pierce tube. It is shown in Figs. 3-8, 7-6 and 7-8. Fig. 7-6 is a simplified schematic diagram. The output of the analyzer r-f oscillator is frequency-modulated by applying a sawtooth voltage taken from the sweep circuits of the oscilloscope to the reflector electrode of the tube. The output of the oscillator is mixed with the incoming r-f input signal to obtain the intermediate frequency. It is also used in conjunction with the frequency meter to produce the frequency meter pip that is used as an indicator in frequency measurements.

(2) The analyzer r-f oscillator employs a Type 2K25 tube as a Shepard-Pierce oscillator. A type 723A/B may be substituted. This tube is illustrated in Fig. 3-8. It is a reflex type variable-cavity oscillator. It contains an electron gun to emit electrons into the shell or cavity. The cavity is 300 volts positive with respect to the cathode. The electrode in the top of the tube is the reflecting anode and is about 140 volts negative with respect to the cathode. Heater power is obtained from transformer T-102.

(3) Each end of the cavity contains a grid as shown in Fig. 3-8. The electrons from the cathode are accelerated as they pass through these grids. The polarities of the grids are changing with respect to each other at the frequency of the oscillator. If a group of electrons arrive at the first grid when it is positive, the electrons are accelerated and pulled away from the electrons that immediately follow. If the second grid is still negative when the group of electrons arrive before it, the group will be slowed up and bunched closer together.

(4) If the second grid is not negative the electrons pass through to the negative reflector where they are repelled back into the cavity. If the electrons arrive back at the cavity in phase with the a-c potential of the cavity, they reinforce the bunching effect. That is, they deliver up energy to the cavity.

(5) The result of this action is a velocity-modulated stream of electrons flowing in the cavity. As the bunched electrons pass through each grid it becomes alternately positive and negative. The frequency of this oscillating action is determined by the spacing between the two grids, the volume and shape of the cavity, the spacing between the reflector and the cavity, and the voltage on the reflector. Assuming that the d-c potentials on the cathode and cavity are constant, the spacing and reflector voltage act to control the transit time of the electrons, which fixes the frequency of oscillation.

(6) The analyzer r-f oscillator may be tuned in either of two ways. One way is by means of a me-

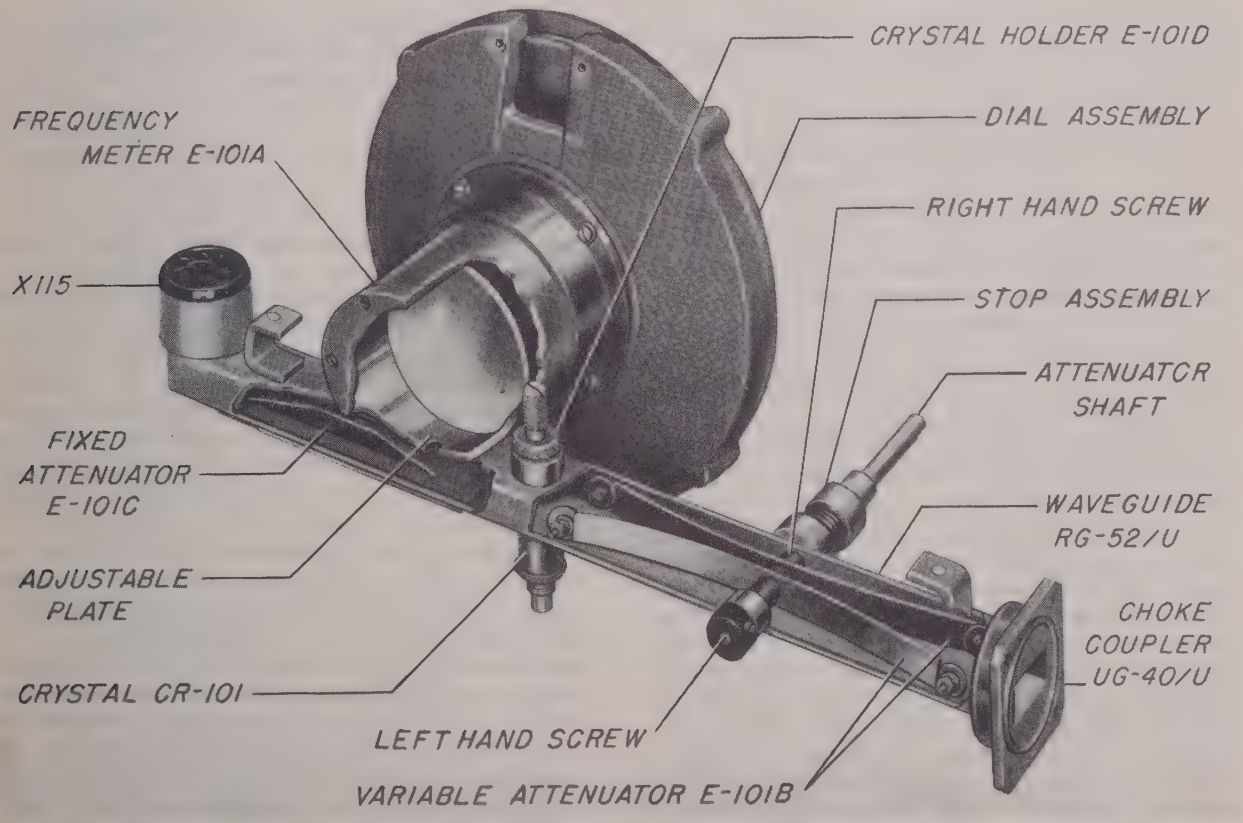


Figure 3-7. Wave Guide Assembly, Cut-Away View

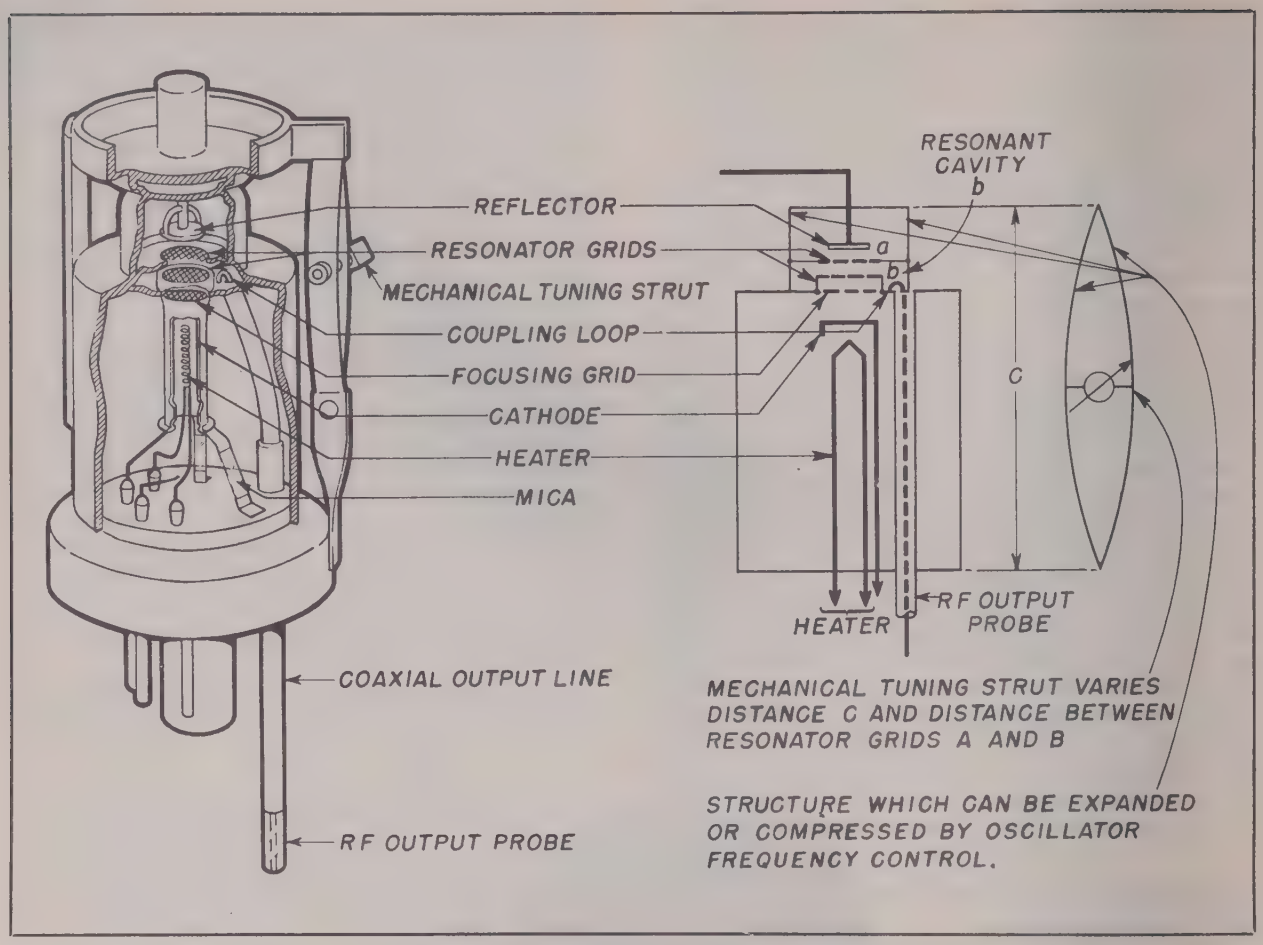


Figure 3-8. Analyzer R-F Oscillator Tube

chanical screw. This screw is rotated by the OSCILLATOR FREQUENCY control on the front panel. This control is the coarse frequency control. It places a stress on a pair of struts on the side of the tube. As these struts lengthen they expand the cavity to increase the spacing between the two grids and vary the capacity in the resonant circuit.

(7) The other method is to vary the voltage on the reflector electrode. The reflector voltage may be varied in two ways:

(*a*) The SPECTRUM CENTER control varies the negative d-c potential on the reflector. This control is the fine frequency control and is the first method for varying the reflector voltage. The d-c component of the reflector voltage is obtained from a voltage divider across the negative high voltage supply. The magnitude of this voltage is controlled by the setting of potentiometer R-167 (SPECTRUM CENTER) in the voltage divider. Actually the Type 2K25 or 723A/B tube will only oscillate within definite ranges of reflector voltage. These ranges are called modes. This Analyzer makes use of the modes that appear in the —100 to —180 volt range. The mode or range moves as the mechanical tuning is varied so that it is necessary to keep it centered on the screen by means of the SPECTRUM CENTER control. It may be possible to find more than one mode in the range of —100 to —180 volts. If this is so, use either one since they are essentially the same.

(*b*) The SPECTRUM WIDTH control varies the modulating sweep-voltage on the reflector. Varying the setting of this control varies the width of the frequency band through which the oscillator sweeps. The sawtooth shaped output at the plate of V-103A is applied to the reflector of the Type 2K25 or 723A/B as modulating voltage. This voltage appears across the voltage divider formed by resistors R-152, R-153 and R-154, in series with capacitor C-124. Potentiometer R-153 is the SPECTRUM WIDTH control. Its arm is capacitively coupled to the reflector of V-115. The setting of the arm on resistor R-153 controls the amplitude of the modulating sweep voltage that is applied to the reflector. The reflector voltage is the only variable voltage on the analyzer r-f oscillator, the spaced grids being connected to the regulated 300-volt supply.

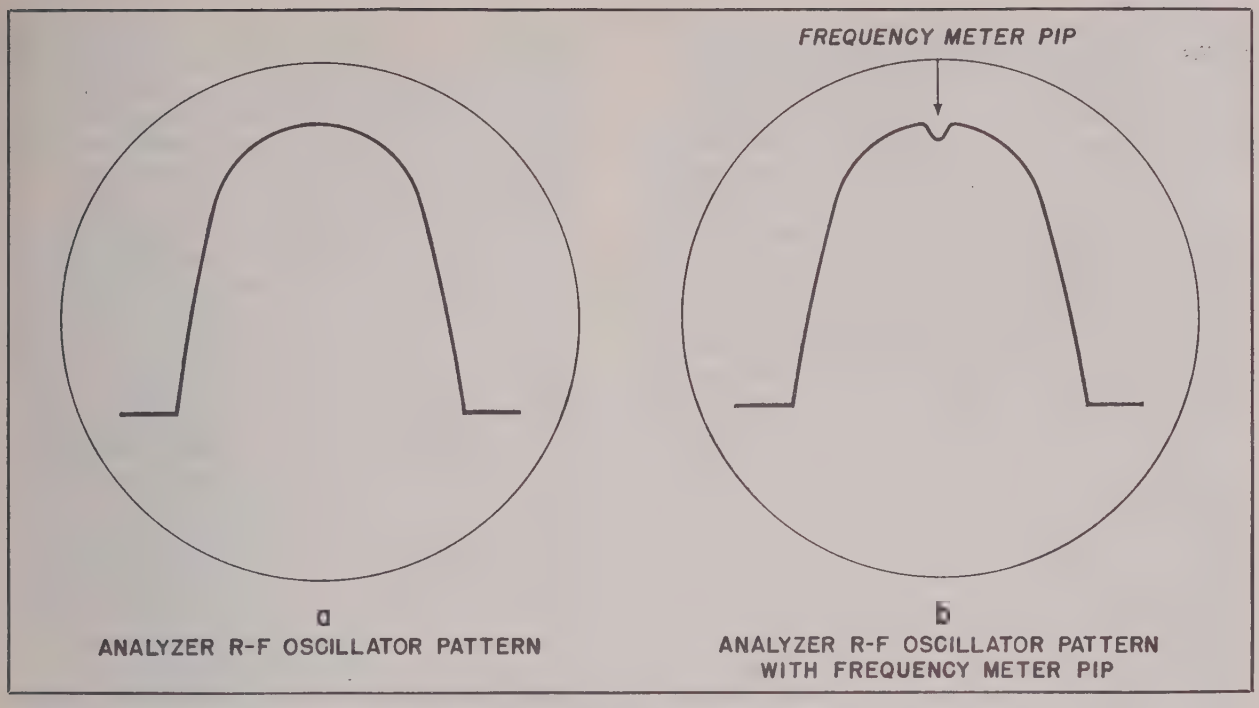


Figure 3-9. Analyzer R-F Oscillator Pattern

(8) The output of the analyzer r-f oscillator varies in amplitude for different instantaneous values of reflector voltage. Due to the rectifying action of the crystal the d-c mixer amplifier produces the characteristic pattern in Fig. 3-9. If the slope of the curve differs greatly from the one in Fig. 3-9 the oscillator is not properly tuned or if tuning does not materially correct the pattern, the Type 2K25 or 723A/B is probably defective and should be replaced.

(9) It is necessary to frequency-modulate the analyzer r-f oscillator in order to display on the scope screen each frequency component of the signal under observation. Frequency modulating the analyzer r-f oscillator produces a 22.5-mc/s i-f signal for each frequency component in the signal under test. If the analyzer r-f oscillator is swept from a low frequency to a high frequency, a series of i-f signals will be produced that represent the spectrum of the signal under observation.

(10) The signal at the beginning of the sweep represents the lowest side-band frequency and it will be followed in turn by the higher side-band frequencies until the fundamental frequency is reached. The succession of i-f signals continues through the upper side-bands until the highest frequency is reached. Since the trace on the scope is synchronized in time with the frequency swing of the analyzer r-f oscillator, the side-band frequencies will be spread out from left to right as shown in Fig. 3-10.

(11) It can be seen that there is a definite, fixed relationship between the modulating voltage and the deflecting voltage at any given instant, for any setting of the controls. Since the frequency of the analyzer r-f oscillator changes directly with the modulating voltage, it follows that the analyzer r-f oscillator frequency (and the intermediate frequency) bears a definite time relationship to the position of the trace-forming electron beam. See Fig. 2-14.

(12) It is necessary to think of the trace in terms of frequency divisions rather than time divisions. If the frequency components that cause the vertical deflection vary in amplitude, the envelope of the pattern represents a curve of amplitude plotted against frequency.

c. FIXED ATTENUATOR.

(1) The fixed attenuator in Fig. 3-7 isolates the analyzer r-f oscillator from the rest of the wave-guide so that it is unnecessary to make any adjustments on the mixer when tuning over the frequency range. In fact, no adjustments are provided. The power from the analyzer oscillator goes past the frequency meter where a small portion of it is absorbed by the cavity of the frequency meter. A portion of the remainder is absorbed by the crystal and the part that is not absorbed by the crystal goes past the variable attenuator and out into the wave-guide. This is the part that is utilized when the Analyzer is used as a signal generator.

d. FREQUENCY METER

(1) The frequency meter is a high Q cylindrical cavity type meter with a mechanically variable length.

It is marked E-101A in Figs. 3-7 and 7-8. The dial has been accurately set at 9310 mc/s and will not vary more than ±5 mc/s under normal temperature and humidity conditions. However, the accuracy will vary with temperature and humidity. The frequency range of the meter is 8470 mc/s to 9630 mc/s. Temperature and humidity corrections may be obtained by using nomographs such as those appearing in the handbooks for the TS-13/AP and the TS-146/UP.

(2) Each time the frequency of the analyzer r-f oscillator sweeps through the frequency to which the frequency meter is tuned, the meter absorbs some of the output power. This absorption results in a sharp reduction of the analyzer r-f oscillator component of the crystal current. This reduction, or pip, is applied to the d-c mixer amplifier and is used to indicate the coincidence of the frequency meter with unknown frequencies on the scope screen.

(3) The reduction of the amplitude of the analyzer r-f oscillator frequency causes a corresponding reduction in the amplitude of the i-f signal that is easily distinguishable if the scope pattern is watched carefully.

e. CRYSTAL MIXER.

(1) The crystal mixer consists of parts E-101D and CR-101 in Figs. 3-7 and 7-8. The crystal mixer is used to rectify the heterodyne frequency produced by mixing the r-f signal with the frequency-modulated output of the analyzer r-f oscillator. Whenever the r-f input signal is 22.5 mc/s above or below the frequency of the analyzer r-f oscillator, the i-f amplifier responds to the output of the crystal.

(2) The crystal is placed between the frequency meter and the variable attenuator, as shown in Fig. 3-7. The current through the crystal represents the rectified components of the signals produced by heterodyning the incoming r-f signal with the output of the analyzer oscillator. The i-f component of the crystal output is amplified by the i-f amplifier.

(3) The output of the crystal also contains a rectified component that is proportional to the power output of the analyzer r-f oscillator with respect to frequency. This voltage is amplified by the d-c mixer amplifier and appears on the scope when the SELECTOR switch is in the MIXER position. The pattern produced is used to determine the efficiency of the analyzer r-f oscillator and to set the various controls as described in Section II. It is also used to insure that the analyzer r-f oscillator is tuned to the desired frequency range. Another component present in the crystal output is the pip produced by the frequency meter. The production of this pip is explained later on in this section. The analyzer r-f oscillator components and the frequency meter pip are amplified by the d-c mixer amplifier. In addition to the pip just described, two other pips appear, one on each side of the frequency meter pip. The one on the left indicates the start of the oscillator sweep while the one on the right indicates the end of the sweep.

(4) The crystal is a conventional 1N23A and it may be removed by first loosening the center part of the crystal holder with a screwdriver. The outside part can then be unscrewed with the fingers. This removes the crystal along with the holder. When replacing a crystal, the last operation should be to tighten the center part with a screwdriver. If this center section is tight when the holder is screwed in, the crystal may be broken.

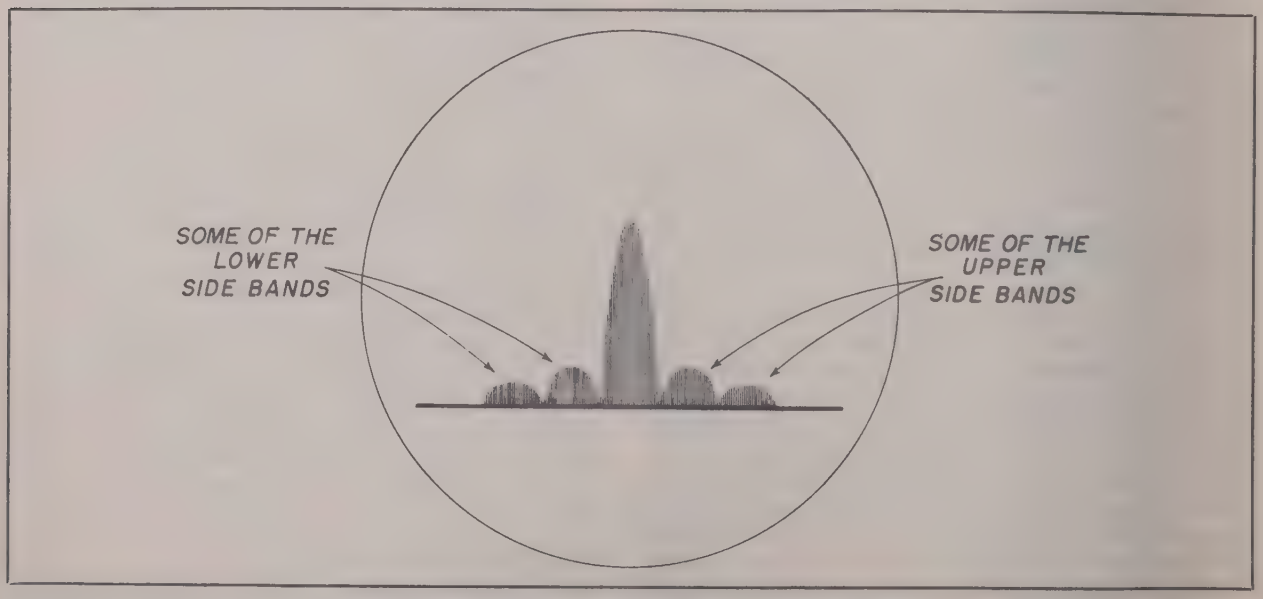


Figure 3-10. Spectrum Displayed on Oscilloscope

CAUTION

WHEN REMOVING OR REPLACING CRYSTALS, BE SURE TO PLACE THE HAND THAT TOUCHES THE CRYSTAL IN CONTACT WITH THE WAVE-GUIDE BEFORE REMOVING OR INSERTING THE CRYSTAL OR TOUCHING THE CRYSTAL TO ANY GROUND. IF THIS IS NOT DONE, A STATIC CHARGE OR POTENTIAL DIFFERENCE MIGHT EXIST THAT WOULD DAMAGE THE CRYSTAL.

f. I-F AMPLIFIER AND DETECTOR.

(1) GENERAL.

(a) The circuits comprising the i-f amplifier are shown in Figs. 7-6 and 7-8. The amplifier consists of a first i-f stage, an oscillator-converter and a detector. The band-pass or band-width of the i-f amplifier has been made very narrow so that two signals that are close together in frequency may be distinguished from each other and a true picture of a spectrum may be obtained.

(2) FIRST I-F AMPLIFIER.

(a) The first i-f amplifier, V-101, uses a Type 6SJ7 tube. This tube is shown in Figs. 7-6 and 7-8. V-101 is a conventional amplifier using iron core tuned coils and fixed d-c bias on the grid. It is included in the circuit to amplify the i-f signal to a level that can be handled satisfactorily by the oscillator-converter. It also prevents the output of the oscillator in the oscillator-converter from appearing in the wave-guide.

(b) Bias is obtained from the voltage divider across the negative high voltage supply. Resistor R-101 and capacitor C-103 decouple the grid circuit from the bias supply. The amplifier has a tuned inductive plate load, L-101, to produce its band-pass characteristic of 500 kc/s. Capacitor C-102 returns the secondary of transformer T-101 to the cathode of V-101.

(c) The resonant frequency of this amplifier is 22.5 mc/s. The output from the crystal-mixer is inductively coupled to the grid of the amplifier, through the tuned transformer T-101. The reactance of the primary of transformer T-101 is sufficiently high at 22.5 mc/s to act as an i-f choke in the grid circuit of the d-c mixer amplifier. Since the output of the analyzer r-f oscillator varies at an audio rate, the bell-shaped oscillator curve does not pass through the i-f amplifier.

(d) The reactance of capacitor C-102 is very low at 22.5 mc/s but it is correspondingly high at audio frequencies. Consequently the amplitude variation of the modulated analyzer r-f oscillator output has no effect at the grid of V-101, because the impedance in the grid circuit is so low that the oscillator sweep voltage can never appear at the grid. The output of V-101 is a series of pulses of 22.5 mc/s. Each pulse represents a section of the spectrum of the r-f signal that is being observed. These are capacitively coupled to the grid of V-102 by capacitor C-105.

(e) The SPECTRUM position of the SELECTOR switch inserts potentiometer R-197 and resistor R-195 between the screen of V-101 and ground. This reduces the screen and plate voltages from 110 volts to approximately 40 volts and reduces the gain of the i-f amplifier 25 db.

(3) OSCILLATOR-CONVERTER.

(a) The second stage in the i-f amplifier uses a Type 6SA7 tube. This tube is V-102 in Figs. 7-6 and 7-8. The primary purpose of the oscillator-converter is to obtain a narrow band-width. The band-width of this stage is 50 kc/s at the half-power points. The oscillator circuit of V-102 is tuned to approximately 19.5 mc/s. The plate load inductor L-103 is fixed-tuned to approximately 3 mc/s.

(b) From Fig. 7-6 it can be seen that the oscillator voltage on grid 5 causes pulses of space current to flow at the positive peak of each oscillator cycle. Grid 8 has the 22.5-mc/s i-f signal voltage on it. The pulses of space current arriving before grid 8 form a virtual cathode whose emission to the plate is controlled by the signal voltage.

(c) Since the virtual cathode does not exist except on the peaks of the oscillator cycles, the plate current varies at the heterodyne frequencies of the original intermediate frequency and the oscillator frequency.

(d) The heterodyne frequency of three megacycles between the incoming intermediate frequency and the oscillator frequency is amplified 5 to 10 times by the oscillator-converter before being passed on to the detector.

(e) The narrow band-pass of this stage is obtained by employing the high Q inductor L-103 in the plate circuit of V-102.

(4) DETECTOR.

(a) The detector stage is shown in Figs. 7-6 and 7-8. It utilizes V-103A, the first half of V-103, which is a Type 6SN7GT tube. An infinite-input-impedance detector is used for simplicity and to minimize the loading effect on inductor L-103. The detector rectifies the i-f signal voltage and the rectified output is applied to the video amplifier for amplification. Since V-103A is a square law detector it produces a power spectrum from the incoming voltage spectrum.

(b) The i-f signal voltage is capacitively coupled to the grid of V-103A through capacitor C-110 and appears across inductor L-105. The junction of the low end of inductor L-105 and cathode resistor R-111 is connected to the arm of potentiometer R-117.

(c) Potentiometer R-117 is the VERTICAL SPECTRUM control on the front panel. It is in series with the negative high voltage terminal, resistor R-118, and ground. It controls the grid-cathode potential of V-103A. This control has no effect on the action of V-103A other than to change its plate-to-cathode

voltage slightly. It is used to control the bias of the video amplifier.

(d) The voltage that appears across the 150,000-ohm cathode resistor keeps the tube biased very near plate current cut-off. Any a-c signal that appears at the grid is automatically rectified or detected because the negative half of the cycle produces very little effect while the positive half causes plate current to flow.

(e) The cathode of V-103A is connected to the grid of the video amplifier V-104 through resistor R-194. Capacitor C-110 by-passes the intermediate frequencies around the cathode resistor. Since V-103A requires a low plate voltage, the plate is connected to the junction of resistors R-110 and R-112, which form a voltage divider between the +300-volt supply and ground. Capacitor C-112 places the plate of V-103A at i-f ground potential.

(5) ALIGNMENT.

(a) If it is suspected that the i-f amplifier is out of tune, it can be checked by picking up a signal and tuning transformer T-101 and inductor L-101 for maximum output on the oscilloscope. Another good way is to measure the frequency separation of the right and left spectrums of a signal. The i-f amplifier is tuned to one-half of this frequency.

(b) If there is reason to believe that inductor L-102 is out of adjustment, its frequency may be checked by picking it up with a communication receiver or frequency meter.

(c) A very good way to align the i-f amplifier is to couple a 22.5 mc/s amplitude-modulated signal into the Type RG-5/U crystal mixer cable. Tune transformer T-101 and inductor L-101 for maximum amplitude on the oscilloscope. If inductor L-102 is out of tune, it should be tuned to beat with a frequency meter that is set at 19.5 mc/s. Always retune transformer T-101 on a signal after reconnecting the Type RG-5/U cable to the crystal mixer.

Note

The i-f amplifiers must be aligned with the SELECTOR switch in its SPECTRUM AMPLIFIED position. Do not attempt to realign the i-f amplifiers with the SELECTOR switch in its SPECTRUM position.

g. VIDEO AMPLIFIER.

(1) The video amplifier employs a Type 6AC7 tube designated V-104 in the circuit diagrams. Its circuit is shown in Figs. 7-6 and 7-8. Except for the direct coupling between its grid and the cathode of the detector, V-103A, this circuit is in every way conventional. Any change in the plate or grid voltage produces a deflection on the vertical plates of the oscilloscope.

(2) When the SELECTOR switch is in the SPECTRUM or the SPECTRUM AMPLIFIED positions, vertical centering is accomplished by adjusting the d-c bias on the grid of V-104. This bias is obtained from the arm of the VERTICAL SPECTRUM control, R-117, through the cathode resistor R-111, and resistor R-114.

(3) Potentiometer R-117 is connected to the negative high-voltage terminal and is in series with resistor R-118. The other end of resistor R-118 is grounded and therefore is positive with respect to the negative high voltage terminal. The voltage across this resistor is high enough to place potentiometer R-117 (and consequently the bias of V-104) at a potential that tends to keep the pattern centered for variations of the a-c power.

(4) Screen voltage is obtained from a simple voltage regulator V-103B, whose grid is held constant in voltage by being tapped off a divider in the +300-volt regulated supply.

(5) The output of the d-c mixer amplifier V-106 is coupled to the grid of V-104 through capacitor C-114. This capacitor, with the resistance in series with the grid and ground, forms a differentiating circuit. Referring to Fig. 3-9, it can be seen that the slope of the analyzer r-f oscillator curve is changing at a slow rate, while the slope of the frequency meter pip is very steep and abrupt. Capacitor C-114 and its associated resistance pass the high frequencies present at the beginning of the curve, the frequency meter pip, and the end of the curve. The result is a grid voltage at V-104 that produces the output shown in Fig. 3-11. Note the two pips on each side of the frequency meter pip that permit determination of the limits of the frequency sweep of the analyzer r-f oscillator and hence the limits of the observable spectrum.

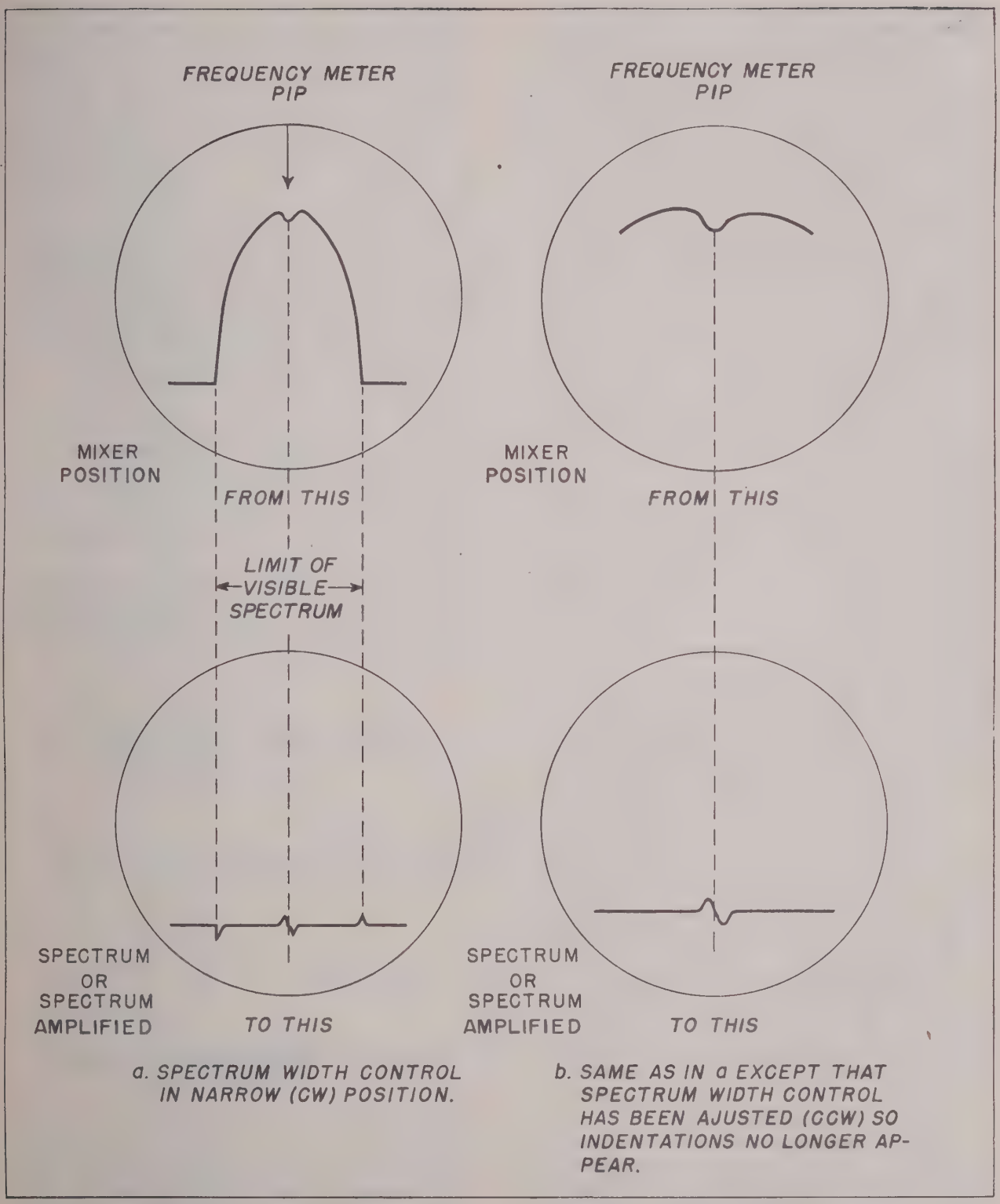
(6) The output of V-104 is negative and is applied directly to the lower vertical plate of the cathode ray tube through the SELECTOR switch S-103, when it is in the SPECTRUM or SPECTRUM AMPLIFIED positions. It is also capacitively coupled to the grid of the intensifier tube, V-109B, which delivers an intensifying voltage to the control grid of the cathode-ray tube.

h. SWEEP OSCILLATOR.

(1) The sweep oscillator is shown in Figs. 7-6 and 7-8. It employs the Type 884 gas filled triode, V-107, in a simple relaxation type sawtooth generator. It generates a voltage to control both the scope trace and the frequency sweep of the analyzer r-f oscillator.

(2) Fixed bias is obtained from the negative voltage divider. Synchronizing voltage is obtained from the high voltage filter circuit by placing R-137, the cathode resistor of V-107, in series with filter capacitor C-135 and ground. SYNC switch S-102 short circuits this resistor to remove the synchronizing voltage. Sweep frequencies between 10 and 30 cps are selected by varying the charging time of capacitor C-120 through the adjustment of potentiometer R-135 in the plate circuit of the tube.

(3) Since capacitor C-120 is connected between the regulated 300-volt supply and ground, it is charged by the supply voltage through resistor R-134 and potentiometer R-135, the SWEEP FREQUENCY con-



a. SPECTRUM WIDTH CONTROL IN NARROW (CW) POSITION.

b. SAME AS IN a EXCEPT THAT SPECTRUM WIDTH CONTROL HAS BEEN AJUSTED (CCW) SO INDENTATIONS NO LONGER APPEAR.

Figure 3-11. Differentiated Frequency Meter Pip in Output of Video Amplifier

trol. The voltage across capacitor C-120 is the voltage applied to the plate of V-107.

(4) With the SYNC switch S-102 in its OFF position the plate voltage of V-107 rises above the firing potential, fixed by the bias on the grid, and the tube conducts heavily. When capacitor C-120 has been sufficiently discharged by the tube to lower the plate voltage to the extinction point, the tube cuts off. Capacitor C-120 immediately begins to charge through resistor R-134 and potentiometer R-135. The rate of charge, and consequently the frequency, is controlled by the adjustment of potentiometer R-135. When capacitor C-120 has charged sufficiently to raise the plate voltage of V-107 to a point where it can overcome the fixed bias on the grid, the tube again acts as a closed switch across capacitor C-120 and the process described above is repeated.

(5) V-107 begins to conduct while the charging rate of the capacitor is still linear with respect to time. Therefore the output is essentially a symmetrical sawtooth wave. This output is applied to grid 1 of the sweep amplifier-inverter, V-108.

(6) The ripple voltage across capacitor C-135 in the high voltage power supply appears across resistor R-137. This resistor is in series with the capacitor and ground. The cathode of V-107 is also connected to this resistor and the ripple voltage appears as a synchronizing voltage at the cathode when SYNC switch S-102 is in the ON position. The frequency of the ripple voltage is the frequency of the line voltage. Therefore it may be used to synchronize the sawtooth modulation applied to the analyzer r-f oscillator with the pulse modulation of any radar equipment that is synchronized to the line frequency. SYNC switch S-102 short circuits resistor R-137 to remove the synchronizing voltage from the cathode of V-107 when it is not necessary to have synchronization.

(7) The synchronizing voltage appears across resistor R-137 as a negative pulse. This pulse lowers the cathode potential of V-107 to make it conduct sooner than it normally would. When V-107 conducts it discharges capacitor C-120 and the next cycle of oscillation starts after the negative synchronizing pulse has passed.

(8) The synchronizing circuit of V-107 possesses the merit of providing a more nearly constant amplitude of synchronizing voltage for a wide range of line frequencies. The charging current of capacitor C-135 is fairly constant and consequently the synchronizing voltage across resistor R-137 is essentially constant.

i. SWEEP AMPLIFIER-INVERTER.

(1) The sweep amplifier-inverter V-108 employs a Type 6SN7GT tube in a push-pull circuit. The circuit of this stage may be seen in Figs. 7-6 and 7-8. The grids of V-108 are connected across a bridge circuit that is balanced for d-c voltage by adjusting the position of the arm of the HORIZONTAL CENTERING control, R-144.

(2) Since the plates of V-108 are directly connected to the horizontal deflection plates of the cathode-ray tube, the position of the trace depends upon the d-c potentials on the plates of the tube. When the bias on the grids is adjusted so that the potentials are equal, the trace will center on the scope screen.

(3) The output of the sweep generator, V-107, is applied to grid 1 of V-108. Its amplitude is controlled by the adjustment of the HORIZONTAL AMPLITUDE control, R-140. The output at plate 2 appears across capacitor C-123 in series with resistors R-147, R-148 and R-149. This circuit comprises a voltage divider to obtain the attenuated signal at grid 4 that is necessary to obtain a balanced output from plates 2 and 5. A portion of the output from plate 2 is used to trigger the back trace remover, V-109A, and to modulate the analyzer r-f oscillator, V-115.

j. BLANKING TUBE (BACK TRACE REMOVER).

(1) If the back trace should be visible on the screen, another spectrum would appear with sufficient intensity to blend into the desired pattern and render it practically worthless. The return of the trace is made invisible by the action of V-109A. V-109A is half of a Type 6SN7GT tube. Its circuit may be seen in Figs. 7-6 and 7-8.

(2) Fixed cut-off bias for this stage is obtained from the negative voltage supply. Plate 2 of V-109A is connected to plate 5 of V-109B since the output of both tubes is applied to the first grid of V-105.

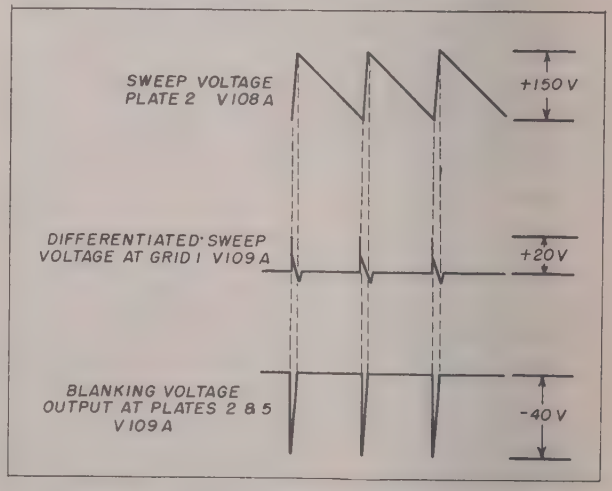


Figure 3-12. Formation of Blanking Trigger From Sweep Voltage

(3) Capacitor C-126 and resistor R-155 form a differentiating circuit that removes the low frequency components of the sweep voltage to produce short positive pulses of voltage as shown in Fig. 3-12. These pulses are applied to grid 1 of V-109A. This stage is operated at plate current cut-off. The output at the plate of V-109A consists of negative pulses synchronized with the steep slope of the sawtooth sweep volt-

age. These pulses are capacitively coupled to the first grid of the cathode ray tube to cut off the electron beam for the duration of the back trace. Since V-109A and V-109B have a common plate circuit, the negative blanking pulses are interspersed with the positive intensifying pulses developed at plate 5 of V-109B. The development of the intensifying pulses is explained in the following paragraph.

k. INTENSIFIER.

(1) The intensifier stage is provided to intensify or brighten the individual signal pulses that make up the spectrum on the screen. This provides better pattern definition because it is unnecessary to turn up the manual INTENSITY control to an abnormal level of brightness in order to be able to distinguish the dim spectrum pulses. The intensifier stage is half of the Type 6SN7GT designated as V-109B in Figs. 3-13, 7-6 and 7-8. It is used as a cathode follower and as an amplifier.

(2) The negative output of the video stage is applied to the grid of V-109B. Positive pulses appear at the plate of this tube each time the video amplifier delivers a pulse of voltage to the vertical plates of V-105. These pulses, mixed with the blanking pulses, are applied to the intensity grid of the scope. The intensifying pulses increase the number of electrons in the beam and brighten the pattern but not the sweep during the time each signal pulse is delivered to the vertical plates of V-105. There are no intensifying pulses in the output of V-109B when the analyzer r-f oscillator sweeps through the zero points between the lobes of the spectrum.

(3) The negative pulses appearing at the cathode of V-109B are applied through capacitor C-121 to the focusing anode of the scope to provide an instantaneous focus correction while the grid is being intensified. The grid bias on this tube is about +40 volts. The cathode voltage rises to approximately +42 or +43 volts giving a resultant bias of —2 or —3 volts. When the negative incoming signal exceeds 40 or 45 volts, the grid is driven past cut-off so that the resulting pulses from the cathode and plate are limited to about —40 and +12 volts respectively.

(4) When the SELECTOR switch is in the MIXER position, the grid of V-109B is grounded to prevent i-f signals and the frequency meter pip from being intensified.

l. D-C MIXER AMPLIFIER.

(1) The d-c mixer amplifier is a conventional circuit using a Type 6SJ7 tube which is designated V-106 in Figs. 7-6 and 7-8. It is used to produce a test pattern of the output of the analyzer r-f oscillator and to produce the frequency meter pip on the spectrum.

(2) The i-f components and also the low frequency component representing the amplitude variation of the analyzer r-f oscillator output in the crystal

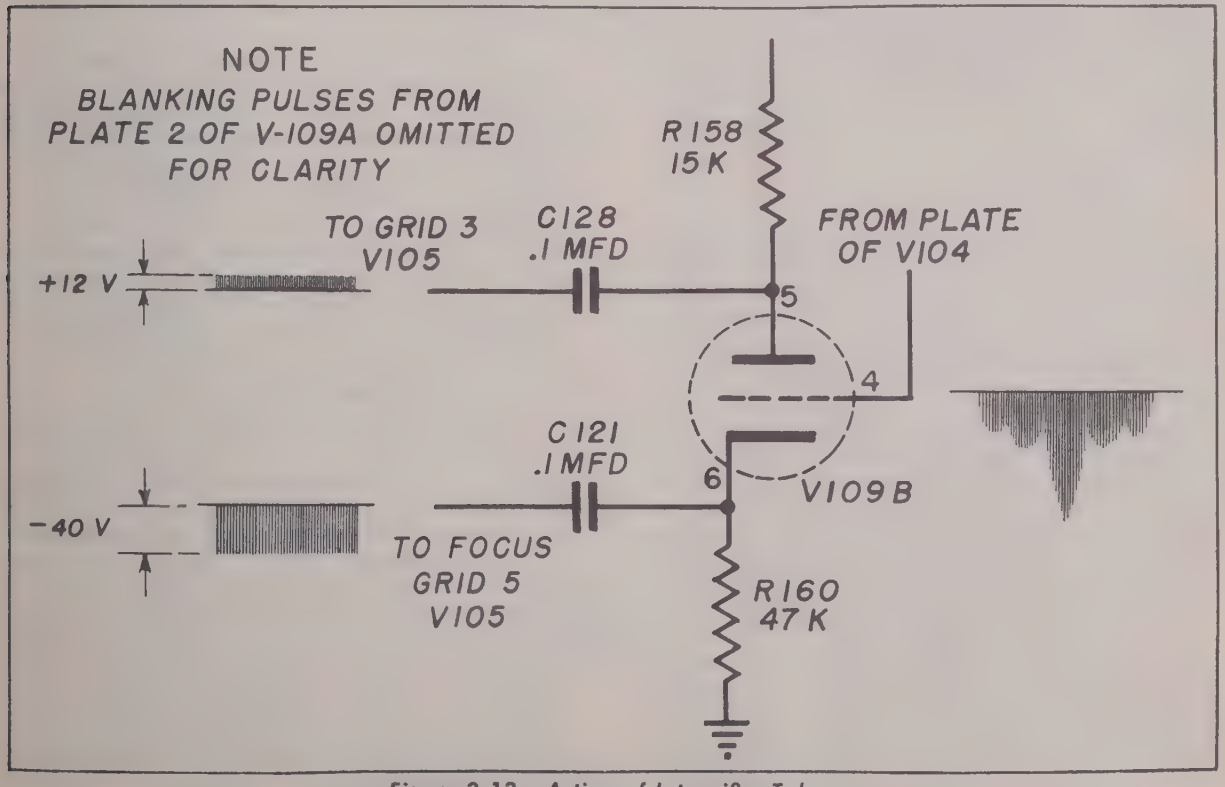


Figure 3-13. Action of Intensifier Tube

output pass through the primary of transformer T-101. Capacitor C-101 provides a path to ground for the i-f components. Resistor R-126 and capacitor C-115B form a low pass filter circuit. This circuit readily passes low frequencies, but offers a high degree of attenuation to high frequencies. It prevents everything from appearing on the grid of V-106 except the rectified voltage that represents the amplitude envelope of the analyzer r-f oscillator output.

(3) The setting of the MIXER AMPLIFIER control R-127 determines the amplitude of the signal voltage on the grid of V-106. Screen voltage and cathode bias are obtained from the voltage divider that is connected between the regulated +300-volt line and ground. Potentiometer R-133 in the voltage divider makes the bias adjustable to control vertical centering. This control is marked VERTICAL MIXER on the control panel. Capacitor C-142 is connected between the plate and ground. The purpose of this capacitor is to place the plate at i-f ground potential. Phone jack J-101 removes the output of the Analyzer's crystal mixer and substitutes the radar crystal mixer, when a transmitter-converter is connected to the jack through a phone cable.

(4) The output is a slowly changing voltage that follows the envelope of the output of the analyzer r-f oscillator. The steep sections of the output wave of V-106 are differentiated by capacitor C-114 and the grid resistance of the video amplifier to produce the frequency meter pips. The output of V-106 is also applied directly to the vertical plates of the cathode-ray tube through the SELECTOR switch when it is in the MIXER position. In this position the bell-shaped curve in Fig. 3-9 is displayed on the screen of the scope.

m. POWER SUPPLY.

(1) GENERAL.

(a) The Spectrum Analyzer is operated from a built-in power supply. A simplified diagram is shown in Fig. 3-14. The complete schematic is shown in Fig. 7-8. The power supply delivers two unregulated output voltages and one regulated voltage. It is designed to operate with a line voltage of 105-125 volts a-c at 50 to 1,200 cps and draw approximately 125 watts. The Analyzer will also function satisfactorily on a line frequency of 1600 cps provided the line voltage is not less than 115 volts. The r-f sensitivity is down about 4 db with a line frequency of 1600 cps. A-c input power is controlled by the ON-OFF switch, S-101. A single transformer, T-102, is used to obtain all a-c and d-c voltages required for operation of the equipment.

(2) HIGH VOLTAGE SUPPLY.

(a) The high voltage supply furnishes voltage for the anodes of the cathode-ray tube. The winding that supplies the a-c voltage for rectification consists of part of the center-tapped winding of transformer T-102 in series with another winding. These windings are the ones between terminals 4 and 6 in Fig 3-14. A Type 2X2 half-wave high-voltage rectifier is connected in a half-wave rectifier circuit. This tube is V-110 in Fig. 3-14. The rectified output is filtered with a capacitor input filter composed of capacitors C-134, C-135 and resistor R-172. The purpose of resistor R-137, in series with capacitor C-135 and ground, is explained in Par. 3*b* of this section.

(b) The output voltage appears across a bleeder or voltage divider, from which the various values of voltages are taken. This voltage divider consists of resistors R-163, R-164, R-165, R-116, and R-166 to R-171 inclusive. The positive side of the high voltage is grounded. The ripple voltage at point F should not exceed 2 volts peak-to-peak.

(c) The three tubes V-116, V-117 and V-118 are Type 991 neon bulbs. They shunt the bottom portion of the voltage divider and are used as voltage regulators. The total voltage regulated by these tubes is approximately —180 volts. The stabilized portion of the voltage divider delivers negative voltage to the reflector of V-115, bias for V-101, V-107, V-108 and V-109. Bias for video amplifier V-104 is obtained from the voltage divider at the junction of resistors R-116 and R-166 in the unregulated portion of the divider.

(3) LOW VOLTAGE SUPPLY.

(a) The low voltage power supply uses a Type 5R4GY tube as a full-wave rectifier. This tube is V-111 in Fig. 3-14. The center-tapped winding between terminals 5 and 7 on transformer T-102 supplies the a-c power.

(b) The rectified output is filtered with a choke-input filter, consisting of inductors L-104 and L-106 and capacitors C-137A and C-137B. The output appears across a voltage divider consisting of resistor R-173 in series with potentiometer R-174 and resistor R-175 paralleled by resistors R-188 and R-189. The unregulated output voltage is taken from the junction of resistor R-173 with potentiometer R-174 and resistor R-188. This voltage source is used to supply voltage to the plates of V-103B, V-104, V-106 and V-108. Potentiometer R-174 is the SPOT ADJUSTMENT control. It controls the d-c potential on grid 9 of V-105. Grid 9 is the focusing anode.

(c) The input to the electronic voltage regulator is taken directly from the filter at choke L-104. The electronic voltage regulator consists of the series regulator tube V-112, the regulator control tube V-113, and the bias voltage regulator, V-114. The cathode of V-112 is connected to ground through the voltage divider which consists of resistors R-180 to R-183 inclusive. Potentiometer R-182 is the +300 VOLTAGE ADJUSTMENT control. Its arm varies the control grid and plate of V-113 and the control grid of V-112 at a positive potential with respect to ground. The voltage across the divider also appears across the shunt resistance of resistor R-179 and V-114 in series. The stabilized voltage across V-114 is used as cathode bias for the control tube, V-113.

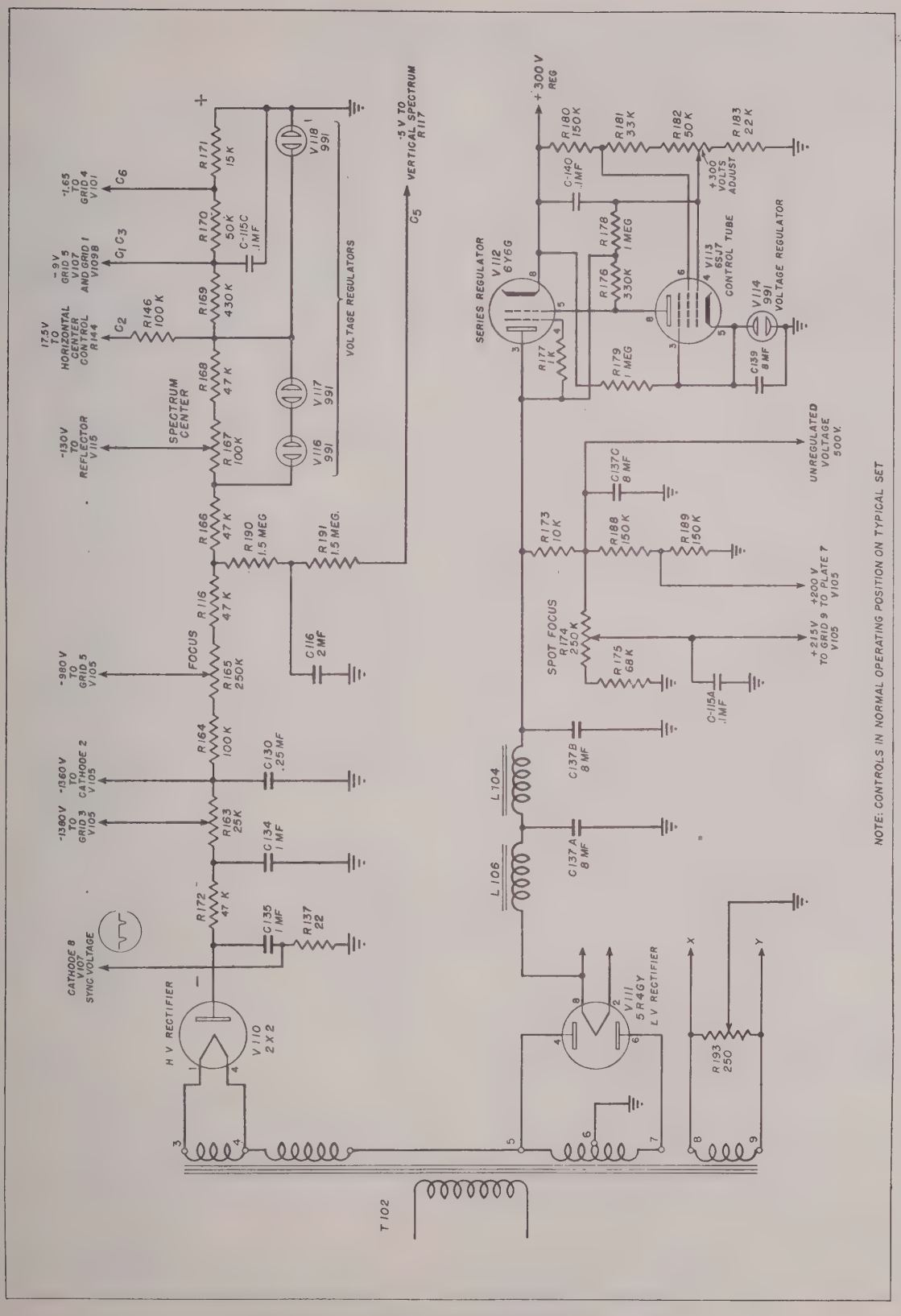


Figure 3-14. Power Supply, Simplified Schematic

(d) Any increase in the load reduces the current in the voltage divider, R-181 to R-183. The reduced potential at grid 4 of V-113 results in a reduced plate current flow since the cathode voltage is held constant by the action of V-114. The voltage gain of V-113 results in a correspondingly large positive swing on the grid of V-112 for a small negative swing on the grid of V-113. The increased positive potential at grid 1 of V-112 allows more current to flow which raises the cathode potential. The above action is reversed for a decrease in the load. The result is a very stable output that remains at +300 volts for wide variations in the load.

(e) As stated previously the voltage out of the regulator may be set to exactly +300 volts with the +300 VOLTAGE ADJUSTMENT control, R-182. The top terminal of resistor R-134 on the terminal board on top of the chassis is a convenient terminal for measuring the voltage when making this adjustment. The ripple voltage from this regulator should not exceed 50 millivolts rms.

(f) Transformer T-102 has five heater windings. One winding heats rectifier V-110, another the filament of V-112. The winding between terminals 1 and 2 heats the cathode-ray tube V-105. The remaining winding supplies filament potential for the pilot lamps and the remainder of the tubes. Potentiometer R-193 shunts this winding to reduce a-c hum. Its arm is grounded. When properly adjusted, it balances both sides of the filament circuit to ground.

SECTION IV
MAINTENANCE

WARNING

DANGEROUS VOLTAGES EXIST IN THE ANALYZER THAT MIGHT CAUSE DEATH. ALWAYS GROUND THE CHASSIS BEFORE TURNING THE A-C POWER ON. MEASURE HIGH VOLTAGES ON A METER WITH A HIGH-RESISTANCE 2,000-VOLT RANGE, OR ON A HIGH-RESISTANCE METER WITH AN EXTERNAL MULTIPLIER TO GIVE THE PROPER RANGE. IT IS BETTER TO CHECK THE OSCILLOSCOPE CIRCUITS WITH RESISTANCE MEASUREMENTS. IF IT IS NECESSARY TO MEASURE THE VOLTAGES, CERTAIN PRECAUTIONS MUST BE OBSERVED TO PROTECT THE LIFE OF PERSONNEL AND TEST EQUIPMENT.

1. PREVENTIVE MAINTENANCE.

a. The Spectrum Analyzer uses a wave-guide and a resonant cavity. To obtain maximum accuracy from the Analyzer certain precautions must be taken.

b. The small side door must be kept closed when the equipment is not in use. The entrance of dirt or moisture into the wave-guide will seriously affect the accuracy of the dial readings.

c. The interior of the Analyzer should be kept free from dust. All assembly screws should be kept tight and the tubes should be checked occasionally to see if they are pushed all the way down into their sockets. All cabling and auxiliary parts should be kept clean and stored away in the Auxiliary and Spare Parts Box when not in use.

2. REMOVING THE DUST COVER.

a. The dust cover is removed by loosening the screw fasteners at the front and rear of the Analyzer. When the fasteners are loosened the dust cover will slide off of the chassis. The bottom of the chassis is divided into two hinged sections that open up like the bomb bay doors on an airplane. The two hinged sections are secured to the chassis with screws which must be removed before the sections will swing outward. See Fig. 5-1.

3. ALIGNMENT.

a. Alignment of the Analyzer requires the use of a high frequency signal generator, 30% modulated with 400 cps, and the tuning wrench that is supplied with the Analyzer. The signal generator should be Navy Type LP-3 or its equivalent. In an emergency, an r-f signal may be used instead of the signal generator. The signal must be modulated.

Note

The SELECTOR switch must be in the SPECTRUM AMPLIFIED position during alignment.

b. To align the equipment proceed as follows:

(1) Remove the dust cover and open up the doors on the chassis.

(2) Remove the crystal mixer cable from the wave-guide and connect it to the output of the signal generator. The crystal mixer cable is shown in Fig. 5-1.

(3) Set the output frequency of the signal generator to 22.5 mc/s and turn the equipment on. Allow both instruments to warm up for approximately 5 minutes.

(4) Tune transformer T-101 for maximum response on the scope. The location of the tuning adjustment is shown in Fig. 5-2.

(5) Tune inductor L-101 for maximum response on the scope. See Fig. 5-2 for location of the tuning adjustment.

(6) Tune inductor L-102 for maximum response on the scope. Make this adjustment only when it is evident that the oscillator is off frequency. This can be determined with any good frequency meter. The adjustment of inductor L-102 is shown in Fig. 5-2.

(7) Repeat the above tuning adjustments.

(8) Remove the signal generator and replace the crystal mixer cable in the wave-guide.

(9) Pick up an r-f signal with the Analyzer and retune transformer T-101 on this signal.

4. TROUBLESHOOTING.

a. GENERAL.

(1) Most of the troubles encountered in the Spectrum Analyzer make themselves apparent by the appearance or non-appearance of one or more of the characteristic curves on the oscilloscope screen. Some of the more common troubles, with the appropriate remedial actions, are listed in the troubleshooting chart below.

WARNING

DANGEROUS VOLTAGES ARE PRESENT IN THE EQUIPMENT, OBSERVE ALL POSSIBLE PRECAUTIONS WHEN WORKING WITH THE EQUIPMENT.

b. VOLTAGE AND RESISTANCE MEASUREMENTS.

(1) All voltages should be measured with a 20,000 ohms-per-volt or 1,000 ohms-per-volt meter. Connect the meter with a-c power off. Discharge all high voltage capacitors and attach a meter lead to the chassis first and then attach the other lead to the point under test. Observe the proper polarity. Place the meter on its highest range and reduce the range to obtain midscale deflection.

TROUBLESHOOTING CHART.

SYMPTOM	*TROUBLE LOCATION*	*PROCEDURE*
(1) Very small output curve or none at all when SELECTOR switch is in MIXER position and MIXER AMPLIFIER all the way on (cw).	(1) Defective crystal.	(1) Replace crystal.
	(2) Abnormal voltages on V-115. (2K25).	(1) Measure voltages. (2) Check operation of power supply.
	(3) V-115 defective.	(1) Replace V-115.
	(4) V-106 or its circuits defective.	(1) Check voltages. Replace V-106 if necessary.
(2) With SELECTOR switch in MIXER position there is vertical deflection on scope but analyzer r-f oscillator curve does not appear.	(1) No modulating voltage on V-115.	(1) Check output of V-108 and coupling circuit to V-115 with a test scope.
	(2) V-106 defective.	(1) Replace V-106.
	(3) V-108 defective.	(1) Replace V-108.
	(4) Incorrect voltages on V-106 or V-108.	(1) Check voltages and resistances.
(3) Trace on scope jumps up and down. SELECTOR switch in SPECTRUM AMPLIFIED or SPECTRUM position.	(1) Low line voltage.	(1) Check line voltage to see that it is above 105 volts.
	(2) Oscillation in neon bulbs V-114, V-116, V-117, V-118.	(1) Substitute neon bulbs one at a time to determine defective bulb.
	(3) Low output from V-110.	(1) Check negative high voltage supply.
(4) Low spectrum amplitude. Operation all right when SELECTOR switch is in MIXER position.	(1) Defective crystal.	(1) Replace crystal.
	(2) Broken resistance card in variable attenuator.	(1) Examine attenuator and replace resistance card if broken.
	(3) I-F amplifier out of alignment.	(1) Align i-f amplifier. See Par. 3, of this section.
(5) Mechanical vibration of Analyzer causes trace to jump up and down.	(1) V-102, V-103 or V-104 microphonic.	(1) Substitute tubes one at a time. If microphonic, replace with good tube.
(6) No spectrum when SELECTOR switch is in SPECTRUM AMPLIFIED or SPECTRUM position. Oscillator pattern normal in MIXER position.	(1) Variable attenuator stuck in maximum attenuating position.	(1) Free resistance card or replace defective parts.
	(2) Abnormal voltages or defective tubes in i-f amplifier.	(1) Check tubes and voltages.
	(3) Open coupling capacitor in i-f amplifier.	(1) Trace signal with scope to determine location of defective capacitor.
	(4) 19.5-mc/s oscillator inoperative.	(1) Check oscillator circuit
	(5) I-F amplifier out of alignment.	(1) Align i-f amplifier. See Par. 3, of this section.
(7) Right end of horizontal trace jitters back and forth.	(1) Sweep frequency not synchronized with line frequency.	(1) Turn SYNC switch ON or adjust SWEEP FREQUENCY Control until jitter disappears.

Do not touch the voltmeter when making high voltage measurements. Average voltages are given in Fig. 4-1. Figs. 5-1 to 5-4 show the location of the tubes and other parts.

(2) All resistances are measured from the test point to ground unless otherwise stated. Generally speaking, measured resistance values should be within plus or minus 10% of the stated value. Average resistances are given in Fig. 4-1. Point to point resistance measurements are given in Table V of this section.

c. TEST EQUIPMENT REQUIRED.

(1) For testing the Spectrum Analyzer TS-148/UP the following test equipments are recommended. The first named unit in each group is preferred, the other being alternate equipment which may be used if the preferred unit is not available.

(*a*) 1,000 ohms-per-volt readings: TS-297/U multimeter, or Weston 663 or Simpson 443.

(*b*) 20,000 ohms-per-volt readings: TS-352/U, or Navy "OE" multimeter, or Simpson 260 or Weston 790.

(*c*) Tube tester: Signal Corps Type I-177A, or Hickok 540 or 545.

(*d*) Vacuum-tube voltmeter: TS-375/U, or RCA-165 (D.C. only), or Radio City Products 662.

(*e*) Frequency Meter TS-186/AP.

(*f*) Oscilloscope: TS-239/UP, or TS-34/AP.

(*g*) Signal Generator: TS-147/UP or LP-3.

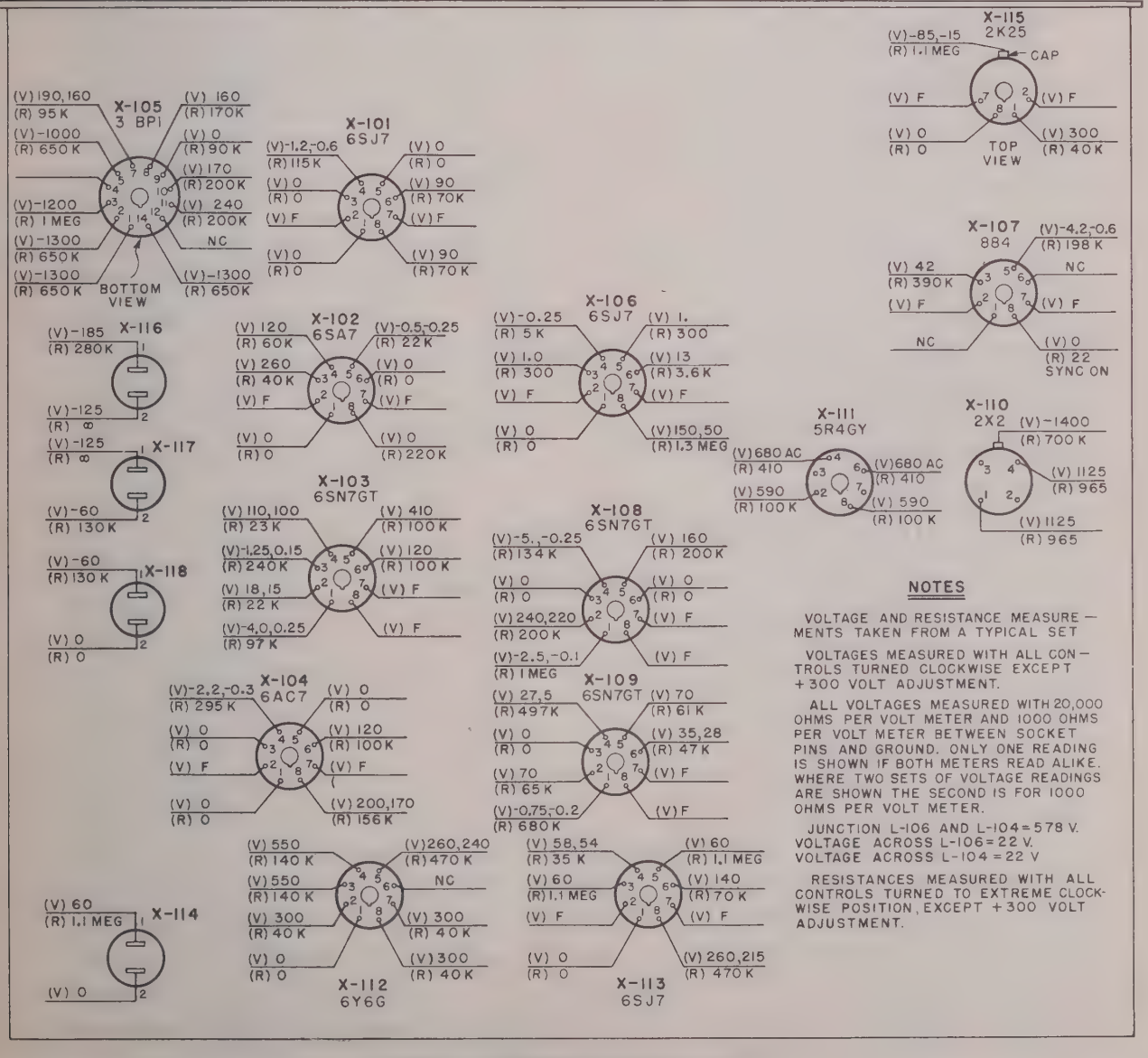


Figure 4-1. Voltage and Resistance Chart

TABLE IV. RESISTANCE MEASUREMENTS

Note: The point-to-point resistances given below should be made with a sensitive ohmmeter. All potentiometers should be turned clockwise as far as they will go.

TABLE IV

CHECK POINTS	*RESISTANCE*
Note: K = 1000	
(1) X-101 Pin 6 or 8 to X-112 Pin 8 (positions 1 and 3)	30 K
(2) X-102 Pin 8 to L-101 Ter. 1	287 K
(3) X-102 Pin 4 to X-102 Pin 3	15 K
(4) X-103 Pin 1 to C-116	910 K
(5) X-103 Pin 1 to L-103 Ter. 1	96 K
(6) X-103 Pin 1 to X-103 Pin 3	150 K
(7) X-103 Pin 2 to L-103 Pin 2	332 K
(8) X-103 Pin 3 to X-104 Pin 4	48 K
(9) X-103 Pin 4 to X-106 Pin 6	22 K
(10) X-103 Pin 5 to X-104 Pin 8	56 K
(11) X-103 Pin 5 to X-104 Pin 2	47 K
(12) X-103 Pin 5 to X-106 Pin 8	1 Meg.
(13) X-103 Pin 5 to X-112 Pin 3	10 K
(14) X-103 Pin 6 to X-104 Pin 6	0
(15) X-104 Pin 8 to X-105 Pin 8 (S-103 in position 2 or 3)	0
(16) X-105 Pin 1 and 2 to X-110 Cap	72 K
(17) X-105 Pin 1 and 2 to X-105 Pin 3	253 K
(18) X-105 Pin 1 and 2 to X-105 Pin 5	200 K
(19) X-105 Pin 3 to C-128	33 K
(20) X-105 Pin 8 to X-106 Pin 8 (S-103 position 1)	0
(21) X-105 Pin 10 to X-105 Pin 11	200 K
(22) X-106 Pin 4 to T-101 Ter. 1 (Crystal Cable Disconnected)	5 K
(23) X-106 Pin 6 to X-106 Pins 3 and 5	3.3 K
(24) X-107 Pin 3 to C-122	100 ohms
(25) X-107 Pin 5 to C-115 C	133 K
(26) X-107 Pin 5 to C-119 B	33 K
(27) X-108 Pin 1 to C-122	1 Meg
(28) X-108 Pin 1 to X-108 Pin 4	1.3 Meg.
(29) X-108 Pin 4 to C-123	2.2 Meg.
(30) X-109 Pin 1 to C-119	517 K
(31) X-109 Pin 1 to C-115 C	617 K
(32) X-109 Pin 4 to X-109 Pin 5	518 K
(33) X-109 Pin 2 to C-127	15 K
(34) X-109 Pin 4 to X-109 Pin 3 (S-103 position 1)	0
(35) X-111 Pin 2 to X-112 Pin 3	620 ohms
(36) X-111 Pin 2 to X-106 Pin 8	1 Meg.

TABLE IV (Continued)

CHECK POINTS	*RESISTANCE*
Note: K=1000	
(37) X-111 Pin 2 to X-108 Pin 2 or 5	110 K
(38) X-111 Pin 2 to X-103 Pin 5	10 K
(39) X-111 Pin 2 to X-104 Pin 8	66 K
(40) X-111 Pin 2 to X-105 Pin 8 (S-103 in position 2 or 3)	66 K
(41) X-112 Pin 3 to X-112 Pin 4	1 K
(42) X-112 Pin 3 to X-112 Pin 5	330 K
(43) X-112 Pin 3 to X-113 Pin 4	1 Meg.
(44) X-112 Pin 3 to C-137 A	310 ohms
(45) X-112 Pin 5 to X-113 Pin 8	0
(46) X-112 Pin 8 to X-113 Pin 6	150 K
(47) X-112 Pin 8 to X-113 Pin 3	1 Meg
(48) X-112 Pin 8 to X-102 Pin 3	2.2 K
(49) X-112 Pin 8 to X-109 Pins 2 and 5	115 K
(50) X-112 Pin 8 to X-109 Pin 4	603 K
(51) X-112 Pin 8 to X-107 Pin 3	330 K
(52) X-112 Pin 8 to X-101 Pin 6 or 8	30 K
(53) X-112 Pin 8 to X-103 Pin 2	53 K
(54) X-112 Pin 8 to X-106 Pins 3 and 5	69.3 K
(55) X-112 Pin 8 to X-106 Pin 6	66 K
(56) X-115 Cap to C-125	0
(57) X-117 to C-115 C	430 K
(58) X-117 to C-119 C	100 K
(59) X-117 to R-143	100 K
(60) X-117 to R-145	150 K
(61) C-115 B to T-101 Ter. 1	100 ohms
(62) C-125 B to C-124	150 K
(63) C-125 B to ground	101. K
(64) V-116 to C-116	1.547 Meg.
(65) V-116 to V-117	147 K
(66) T-102 Ter. 14 to junction J-102 and C-132 (S-101 ON)	0
(67) T-102 Ter. 13 to junction J-102 and C-133 (S-101 ON)	0
(68) T-102 Ter. 14 to T-102 Ter. 15	2.6 ohms
(69) T-102 Ter. 4 to T-102 Ter. 6	1 K
(70) T-102 Ter. 5 to T-102 Ter. 6	400 ohms
(71) T-102 Ter. 6 to T-102 Ter. 7	400 ohms

d. REPLACEMENT OF TUBES.

(1) Tubes should be inspected periodically. They should be replaced whenever a good emission test, mutual conductance test or substitution test shows them to be defective.

5. REPLACING THE CATHODE-RAY TUBE.

a. Before attempting to replace the cathode-ray tube V-105, determine that all power has been removed from the equipment. The operation of the cathode-ray tube circuits involves the use of high voltages which are dangerous to life. Use caution also in the handling of the cathode-ray tube itself to avoid dropping. Breakage of the cathode-ray tube will cause danger from flying glass.

b. The cathode-ray tube V-105 may be replaced by following the procedure described below.

(1) Remove the dust cover as described in Paragraph 2 of this section.

(2) Place the spectrum analyzer on the workbench with the top of the chassis face up.

(3) Remove the front panel scope escutcheon, by unscrewing the four mounting bolts from the escutcheon plate.

(4) Loosen the two captive screws at the base of the cathode-ray tube clamp.

(5) Grasp the tube socket and push gently but firmly with a slight twisting motion. Hold one hand on the face of the cathode-ray tube to prevent dropping or breakage.

(6) Remove the socket from the tube base pins.

(7) Insert the replacement tube with the tube base pin guide facing up.

(8) Slowly push the cathode-ray tube into its shield, overcoming the friction of the rubber moisture seal, until the tube is recessed slightly behind the front panel.

(9) Replace the front panel escutcheon.

(10) Insert the tube socket onto the cathode-ray tube base pins.

CAUTION

Use extreme caution in making the following alignment checks on the cathode-ray tube. The cathode-ray tube circuits operate at high voltages which are dangerous. Turn the power off before making any adjustments to the cathode-ray tube.

(11) Apply power and check that the horizontal base line is lined up with the two viewer guide pins in the front panel bezel. If the cathode-ray tube pattern is not properly aligned, twist the tube slightly to obtain a horizontal base line. After a trace is obtained, it may be necessary to adjust the SPECTRUM and MIXER centering controls. If the horizontal base line is not aligned with the two viewer pins in the front panel bezel, with S-103 in the MIXER, SPECTRUM, or SPECTRUM AMPLIFIER positions, one or both of the centering controls must be adjusted. Set S-103 to the MIXER setting and adjust the MIXER center control so as to properly align the trace. Set S-103 to either SPECTRUM or SPECTRUM AMPLIFIED and adjust the SPECTRUM centering control for alignment of the horizontal base line.

(12) Tighten the two captive screws at the base of V-105 to secure the cathode-ray tube.

6. REPLACING THE KLYSTRON TUBE.

a. Turn off all power before replacing the klystron tube V-115. In the case of equipments with serial numbers 1 through 817, the following procedure also applies except for the reference to the klystron tube shield, which is used only on equipments with serial numbers commencing with 1001 and continuing through 1688. In the earlier equipments (serial numbers 1 through 817) a rigid metal ring was used in place of the rectangular shield can.

b. If faulty operation of V-115 is encountered, the klystron tube may be replaced by following the procedure indicated below.

(1) Remove the dust cover as described in Paragraph 2 of this section.

(2) Place the spectrum analyzer on the workbench with the top of the chassis face up.

(3) Loosen the inside collar on the klystron shaft by means of an Allen-head wrench, and slide down on shaft.

(4) Remove the two $^{6}/_{32}$" mounting bolts on the shield, and remove the shield by pulling the shaft up and out of the way.

(5) Loosen the screws holding the slotted mycalex tube clamps, and slide the tube clamps away from the tube base.

(6) Remove the plate cap. V-115 may then be removed for replacement or test.

c. Insertion of the new klystron tube and re-assembly of the shield and shaft assemblies is very simple, but it is important to follow the sequence described below.

(1) Insert the klystron tube and replace the plate cap.

(2) Position and secure the tube clamps.

(3) Position the tube shield.

(4) Fit the square shaft adapter over the klystron tuning shaft. (Note: In some cases it may be necessary to loosen the OSCILLATOR FREQUENCY control bushing to achieve alignment of the shaft and adapter with the klystron tube).

(5) Secure the tube shield.

(6) Push the inside collar up to the panel as far as possible and tighten the collar on the shaft at this point by means of an Allen-head wrench. (Note: If the panel bushing was loosened to achieve alignment, the bushing should be tightened at this point).

7. DIAL ASSEMBLY.

a. The FREQUENCY dial is assembled to the frequency-meter and accurately calibrated at the factory. The dial is relatively free from mechanical defects and should seldom require replacement. When frequency checks indicate that recalibration is required, the entire wave-guide assembly will have to be replaced, since it is extremely difficult, if not impossible, to recalibrate a dial in the field. The procedure to be used in removing the wave-guide assembly if replacement becomes necessary is as follows:

(1) Remove all knobs, VERTICAL CENTER cover, oscilloscope escutcheon and dial escutcheon.

(2) Remove all hexagonal nuts and bushings show on the control panel.

(3) Disconnect and remove main power fuse holder.

(4) Remove spare fuse holder.

(5) Remove the three screws that hold the dial assembly to the control panel.

(6) Remove nameplate from control panel.

(7) Remove handles from control panel.

(8) Remove instruction plate (NP-1634) by removing five small screws fastening it to the main front panel.

(9) Remove selector switch shaft by loosening shaft coupler near selector switch.

(10) Remove OSCILLATOR FREQUENCY shaft by loosening collar back of main front panel and pulling shaft clear of V-115 shield.

(11) Remove shield covering V-115 (723A/2K25).

(12) Remove V-115 repeller connecting clip and take V-115 from socket.

(13) Remove cover from dial shaft.

(14) Lift out cupped spring washer, serrated washer and stop washers. (It may be necessary to remove the burrs on the splined shaft caused by the dial knob set screws before the spline washer can be removed.)

(15) Remove the two screws holding the anchor plate to main front panel.

(16) Knock out pins holding anchor plate to main front panel.

(17) Remove crystal mixer cable W-101 from output of crystal mixer on wave-guide assembly.

(18) Disconnect wiring to V-115 socket.

(19) Disconnect R-152 (150,000 ohms) between R-153 (SPECTRUM WIDTH) control and C-124 (0.5 mf) at C-124 end.

(20) Remove remaining screw holding dial assembly to main front panel.

(21) Remove four screws holding main front panel to chassis framework.

(22) Remove screw holding main front panel to chassis deck by means of an angle bracket.

(23) Remove six screws holding oscilloscope mounting tube to the main front panel.

(24) Remove the two nuts which hold the wave-guide assembly to the chassis deck. These nuts are accessible from the top of the chassis.

(25) Gently work the wave-guide assembly free while holding the main front panel as far away from the chassis framework as the wiring will allow. Remove r-f oscillator end of wave-guide assembly first, rotating about input end of assembly.

b. When the wave-guide assembly has been removed, the replacement wave-guide assembly may be installed. The following procedure for installation of the new wave-guide assembly is recommended:

(1) Carefully work the replacement wave-guide assembly into place, holding the main front panel as far away from the chassis framework as the wiring will allow. Insert input end of wave-guide assembly first, then gently slide r-f oscillator end of assembly into position.

(2) Thread on and tighten securely the two nuts which hold the wave-guide assembly to the chassis deck.

(3) Press the main front panel against the chassis framework and replace the six screws holding oscilloscope mounting tube to the main front panel.

(4) Replace screw holding main front panel to chassis deck by means of the angle bracket.

(5) Replace four screws holding main front panel to chassis framework.

(6) Replace screw which holds lower left-hand corner of dial assembly to main front panel.

(7) Reconnect R-152 (150,000 ohms) to C-124 (0.5 mf).

(8) Reconnect wiring to V-115 socket.

(9) Connect crystal mixer cable W-101 to output of crystal mixer on wave-guide assembly.

(10) Set anchor plate in original position, with anchor pin holes aligned.

(11) Securely fasten anchor plate to main front panel by means of the two screws supplied.

(12) Rotate dial to highest calibrated frequency marking.

(13) Line up stop washers in sequence against left-hand stop on anchor plate.

(14) Follow top-most stop washer with serrated washer.

(15) Install cupped spring washer and dial shaft cover.

(16) Rotate dial using fingers (do not use dial knob) towards the extreme high-frequency end of dial travel.

(17) Note that stop occurs before end of normal dial travel is reached but not before passing the highest frequency calibration mark.

(18) Rotate dial towards the extreme low-frequency end of dial travel.

(19) Note that stop occurs before end of normal dial travel is reached but not before passing the lowest frequency calibration mark.

(20) If requirements listed under (17) and (19) are not met, remove dial shaft cover and spring washer and rotate serrated washer one notch in whichever direction is necessary.

(21) Replace spring washer and dial shaft cover and observe as in (17) and (19).

(22) Repeat procedure outlined in (16) through (21) until requirements listed under (19) and (21) are met or as nearly so as is possible.

(23) Remove dial shaft cover and spring washer and insert pins that fasten anchor plate to main front panel.

(24) Replace spring washer and dial shaft cover.

(25) Carefully insert V-115 (723A/2K25) in socket and attach repeller connecting clip.

(26) Install V-115 shield.

(27) Engage OSCILLATOR FREQUENCY shaft and tighten collar back of main front panel.

(28) Replace selector switch shaft and tighten shaft coupler near selector switch.

(29) Replace and secure instruction plate (NP-1634) by means of the five small screws which fasten it to the main front panel.

(30) Replace handles on control panel.

(31) Replace nameplate on control panel.

(32) Replace and tighten the three screws that hold the dial assembly to the control panel.

(33) Replace spare fuse holder.

(34) Re-install and reconnect main power fuse holder.

(35) Replace all hexagonal nuts and bushings on control panel.

(36) Replace all knobs, VERTICAL CENTER cover, oscilloscope escutcheon and dial escutcheon.

SECTION V
SUPPLEMENTARY DATA

1. TECHNICAL SUMMARY, SPECTRUM ANALYZER TS-148/UP

a. TUBE COMPLEMENT.

QUANTITY	*TYPE*	*CIRCUIT DESIGNATION*	*FUNCTION*
1	6SJ7	V-101	I-F Amplifier
1	6SA7	V-102	Oscillator-Converter
1	6SN7GT	V-103	Infinite-Input-Impedance Detector and Voltage Regulator
1	6AC7	V-104	Video Amplifier
1	3BP1	V-105	Cathode-Ray Tube
1	6SJ7	V-106	D-C Mixer Amplifier
1	884	V-107	Sweep Oscillator
1	6SN7GT	V-108	Horizontal Sweep-Amplifier Inverter
1	6SN7GT	V-109	Back Trace Remover and Intensifier
1	2X2	V-110	H-V Rectifier
1	5R4GY	V-111	L-V Rectifier
1	6Y6G	V-112	Voltage Regulator
1	6SJ7	V-113	Regulator Control
4	991	V-114	Neon Voltage Regulators
..	..	V-116	....
..	..	V-117	....
..	..	V-118	....
1	2K25 (or 723A/B)	V-115	Analyzer R-F Oscillator

b. TECHNICAL CHARACTERISTICS.

Power Supply.....50-1200 cps; 105-125 volts; 125 watts
Frequency swing of analyzer r-f oscillator (sawtooth FM).....40 to 50 mc/s.
First Intermediate Frequency.....22.5 mc/s.
Second Intermediate Frequency.....3.0 mc/s.
Overall I-F band-width at half power points.....50 kc/s.

Receiver gain (2 I-F stages, 1 Video Stage).....100 db
Sensitivity to CW.....{Spectrum amplified position 80 db below 1 watt for 1 inch of deflection on scope
{Spectrum position 55 db below 1 watt for 1 inch of deflection on scope.
Tuning Range.....Limited to frequency range of local oscillator tube 2K25. Characteristics vary with different tubes.
Frequency Meter Range....Calibrated directly from 8470 mc/s. to 9630 mc/s. Tolerance ± 5 mc/s.
Sweep Frequencies.....10 to 30 cps.
Indicator.....Cathode Ray Tube
Information Displayed.....Each frequency component in an r-f signal displayed as power plotted against frequency.
Attenuation.....Uncalibrated, variable between 3 and 70 db
Maximum Dispersion of Spectra.....1.5 mc/s per inch
Power Output.....Approximately 1 milliwatt
Operating Temperature Range.....−40° to +55° C.

2. MODIFICATIONS.

a. ATTENUATOR.

(1) Originally, the attenuator was marked VARIABLE ATTENUATOR and the attenuation increased with a clockwise rotation of the control knob. At Serial No. 75, the direction of the threads on the attenuator shaft was reversed so that the amplitude of the spectrum on the scope would increase with a clockwise rotation of the attenuator shaft. The name of the control was changed to SPECTRUM AMPLITUDE at the same time and overlay nameplates with the new nomenclature were used until Serial No. 220 at which time the panel was changed to include the new nomenclature. When replacing attenuator shafts on serial numbers below 100, be sure the shaft from spare parts is threaded so that the attenuator strips spread apart when the shaft is turned in a clockwise direction.

b. SELECTOR SWITCH.

(1) In order to reduce the effects of r-f leakage into the Analyzer from external sources of interference, circuits were added to permit the sensitivity to be reduced 25 db if the operator so desires. The SPECTRUM INTENSIFIED position of the SELECTOR switch, S-103, was changed to SPECTRUM. When the switch is in SPECTRUM position, a 3.3K resistor, R-195 is connected between screen 6 of V-101 and ground. This drops the plate and screen voltages of V-101 to obtain the reduction in sensitivity necessary to reduce the effects of strong interference. Since the third position of the switch permits V-101 to operate with normal voltages its name was changed to SPECTRUM AMPLIFIED. This change was effective at Serial No. 25 and modifications were shipped for the equipments already delivered.

c. R-F SENSITIVITY CONTROL.

(1) To eliminate variations in sensitivity when the SELECTOR switch is in the SPECTRUM position, a potentiometer, R-197, was added in series with resistor R-195. The adjustment of this control provides compensation for variations in tube and circuit characteristics and permits the sensitivity to be accurately set at 25 db below the SPECTRUM AMPLIFIED level. Potentiometer R-197 has a resistance of 5000 ohms to provide sufficient range of adjustment, and resistor R-195 has been reduced to 100 ohms. This change was effective at Serial No. 490.

d. SWEEP FREQUENCY CONTROL.

(1) In order to insure that the lower limit of the sweep frequency would be 10 cps in all equipments, resistor R-134 was changed from 330K to 470K at Serial No. 230. This change gave a range of 7 to 27 cps.

(2) It was found advisable to increase the upper limit of the sweep frequency to 30 cps and at Serial No. 496, the sweep circuit was modified to provide a range of 10 to 30 cps. Potentiometer R-135 was changed from 1 megohm to 1.2 megohms and resistor R-134 was changed back to its original value of 330K. This change provides a frequency range of approximately 7 to 34 cps which is sufficient to insure a range of 10 to 30 cps under all conditions.

e. LOCAL OSCILLATOR BOARD.

(1) The local oscillator board, E-105, was removed from all Analyzers at Serial No. 174 except for Serial Nos. 176, 177, 179, 180, 181, 182, 185, 187, 192, 193, 195, 196, 197, 203, 208, 213, 218, 232, 238, 242, 262, and 339.

f. APPROACH NAMEPLATES.

(1) It was found that error in frequency readings, caused by backlash in the frequency meter, could be reduced by approaching the correct frequency reading on the dial from a point above or below it. Whether the point was above or below depended upon each individual set. Therefore, an instruction plate was added to the access door to the wave-guide and power receptacle, that stated whether the dial was to be rotated from a low frequency reading to the correct reading or whether it was to be rotated from a higher reading down to the correct reading. This plate was added at Serial No. 25 and removed at Serial No. 495 when the mechanical difficulties in the frequency meter were eliminated. Metal instruction plates will be supplied in modification kits to replace the temporary paper stickers used on the earlier serial numbers.

g. SWEEP DISPERSION.

(1) In order to obtain the correct sweep dispersion, resistor R-154 was changed from 2.2K $\pm$ 10% to 1K $\pm$ 5% at Serial No. 20. Modification kits will be issued for this change.

h. TUBE CLAMP.

(1) A tube clamp was added to V-104 at Serial No. 166. This clamp will be issued in a Modification kit.

i. SERIES RESISTOR.

(1) Resistor R-194, with a resistance of 1K was added in series with the grid of V-104 at Serial No. 25. This resistor will be issued in a modification kit.

j. SPOT FOCUS CONTROL.

(1) Potentiometer R-174 was changed from its original value of 100K to 250K at Serial No. 165.

k. FILTER RESISTOR DISSIPATION.

In order to avoid the possibility of overloading resistor R-173 (10,000 ohms, 2 watts), the power rating was increased to 4 watts by substituting two 20,000 ohm resistors connected in parallel. These resistors were designated R-173A and R-173B. This modification applies to equipments starting with serial number 1001.

l. KLYSTRON SHIELDING.

Additional shielding of the klystron r-f oscillator was found to be desirable. Effective in equipments starting with serial number 1001, the rigid metal ring originally used as a mechanical shield for V-115 was replaced by a rectangular aluminum shield can which serves as both electrical and mechanical shielding for the klystron tube.

m. POWER SUPPLY RESISTOR.

For increased ease of servicing, as well as for better space utilization and decreased weight, filter reactors L-104 and L-106 were combined and encased in a common mounting container in equipments starting with serial number 1001.

n. FREQUENCY METER DIAL KNOB.

In equipment having serial numbers 1001 through 1688, the slotted set screws in the FREQUENCY meter dial knobs were replaced with #10 Allen-head set screws, and an Allen-wrench to fit these set screws was supplied with those equipments.

o. HORIZONTAL SWEEP TRACE.

Effective in equipments starting with serial number 1060, resistor R-131 in the voltage divider for the d-c mixer amplifier V-106 was changed from 3300 ohms to 2700 ohms, tolerance 5 percent. This change makes it possible to adjust the horizontal sweep trace on the scope to at least one inch below the center line, using any JAN 6SJ7 tube for V-106. Whenever it becomes necessary to replace R-131 in any TS-148/UP test set in the field, replacement with the 2700 ohm resistor is recommended.

p. SWEEP FREQUENCY.

Effective in equipments starting with serial number 1170, resistor R-134 in the plate voltage divider of sweep generator V-107 was changed from 330K to 220K, tolerance 5 percent. This change permitted the high sweep-frequency limit of 30 cps to be obtained without resorting to tube selection of either the type 884 (V-107) thyratron or the type 991 (V-118) voltage regulator.

q. DIRECTIONAL COUPLER CG-176/AP.

A 20 decibel directional coupler (CG-176/AP) was supplied starting with equipment serial number 1001 for extremely stable coupling of the spectrum analyzer to equipments under test.

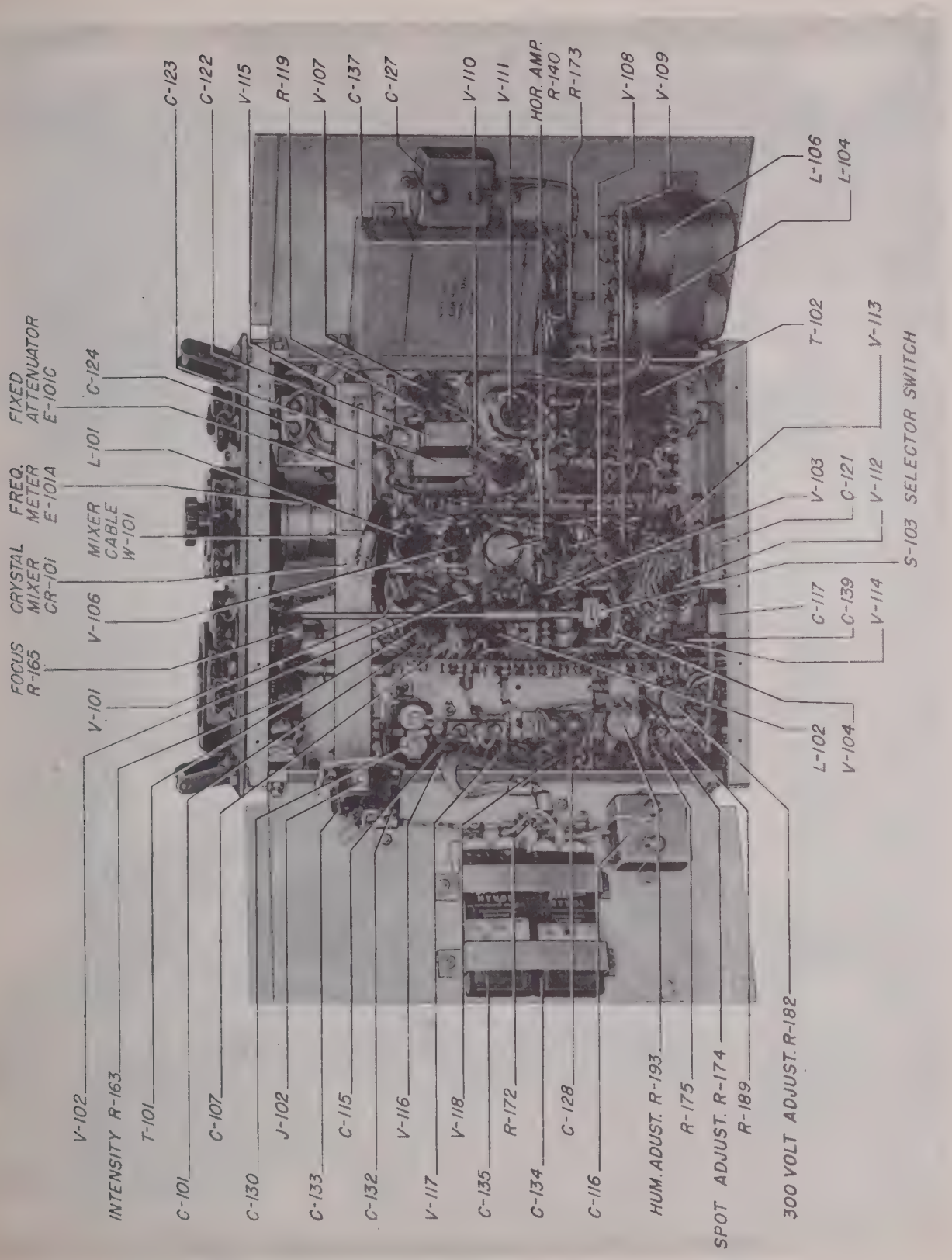


Figure 5-1. Spectrum Analyzer, Bottom View (Serial Nos. 1 to 490)

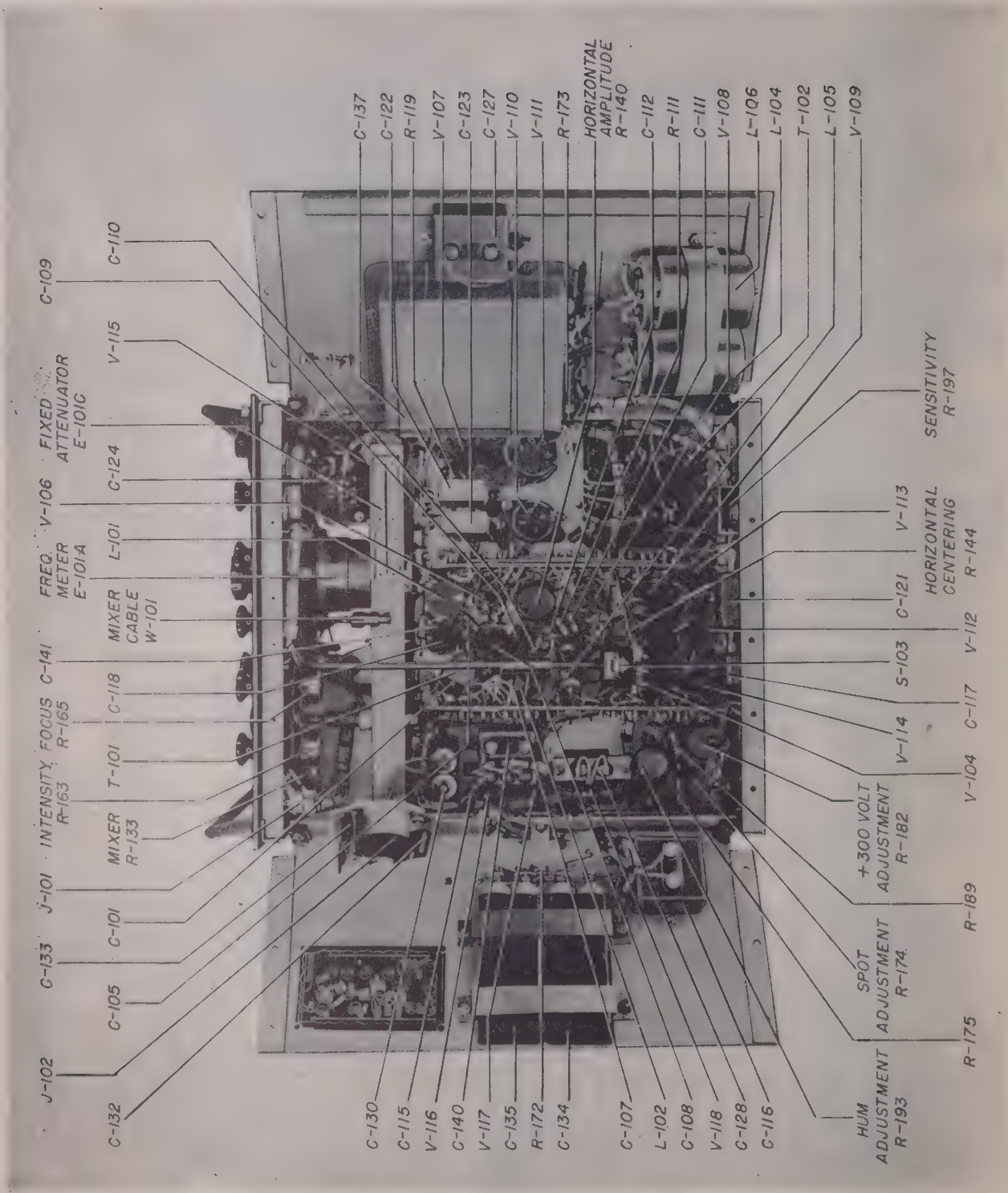


Figure 5-2. Spectrum Analyzer, Bottom View (Serial Nos. 491-817)

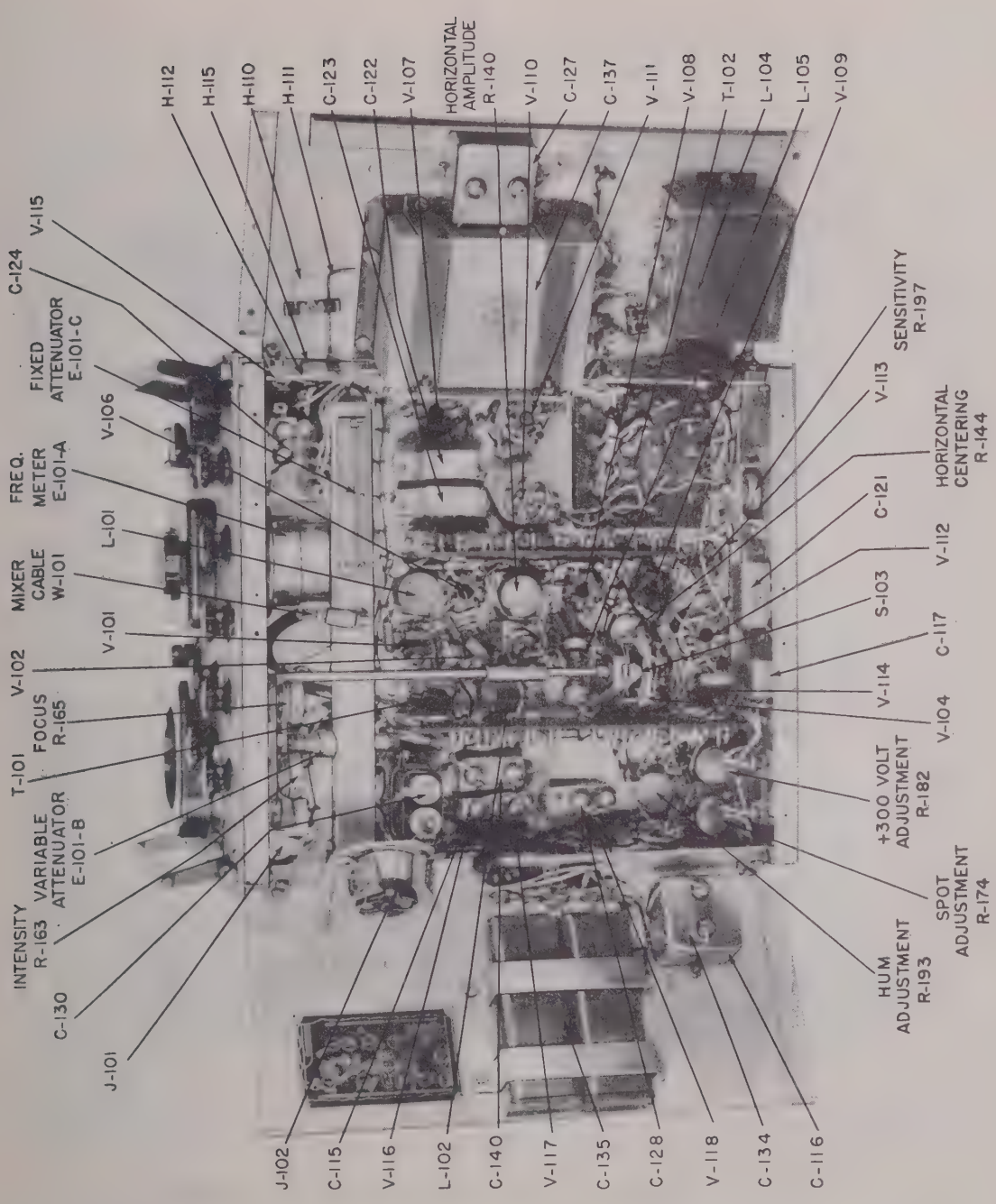


Figure 5-2A. Spectrum Analyzer, Bottom View (Serial Nos. 1001-1688)

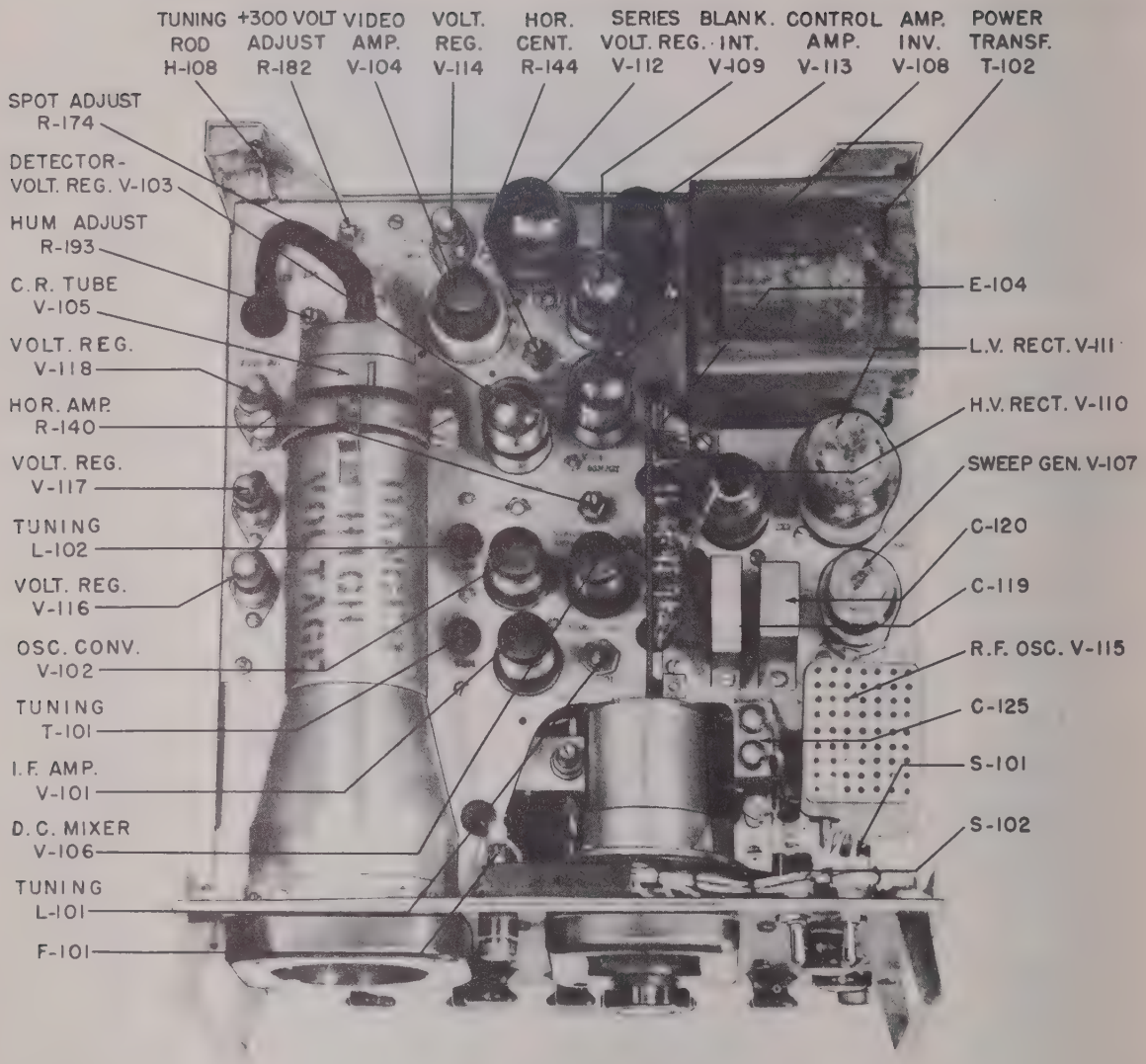


Figure 5-2B. Spectrum Analyzer, Top View (Serial Nos. 1001-1688)

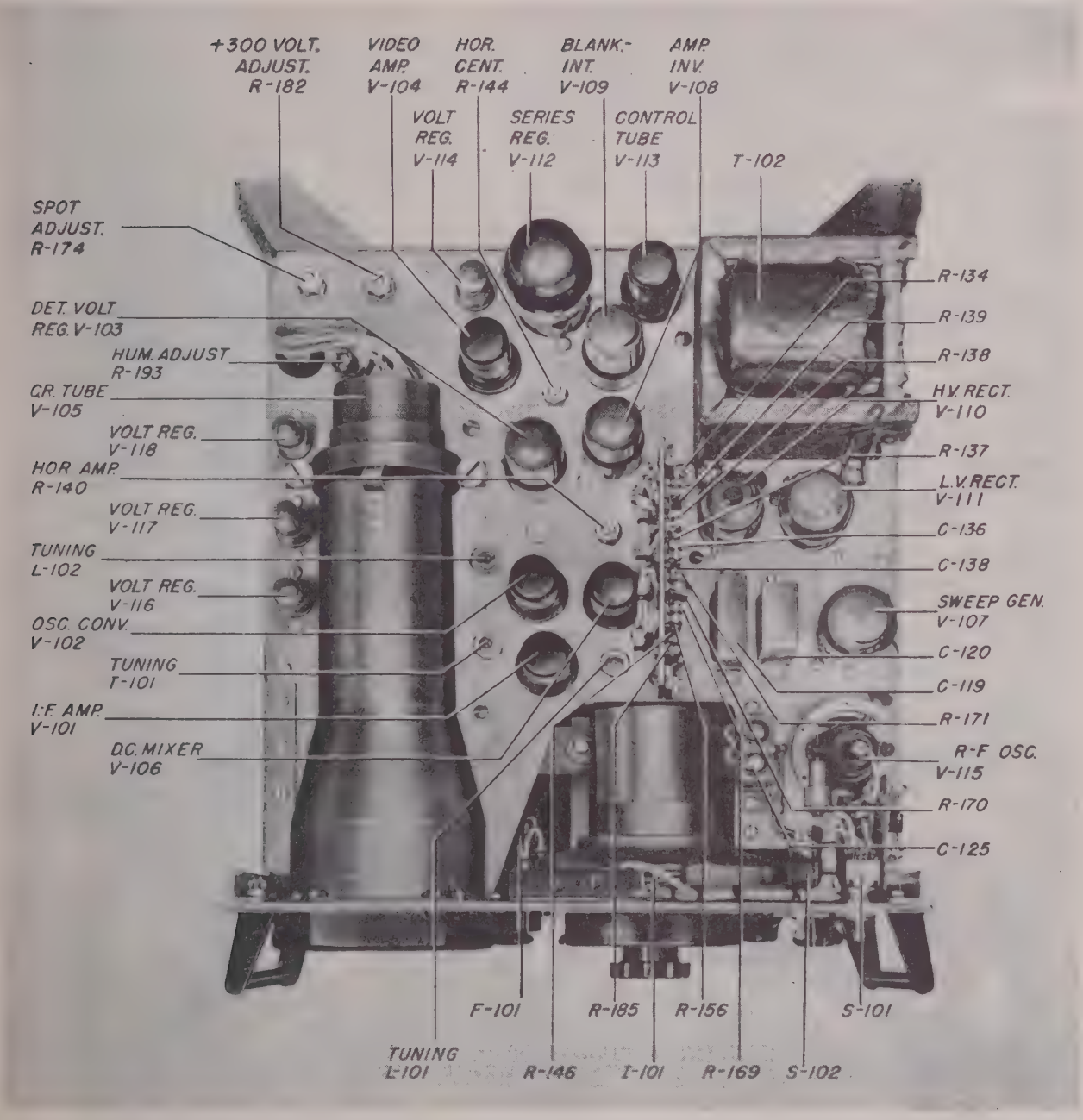


Figure 5-3. Spectrum Analyzer, Top View (Serial Nos. 1 to 174, inclusive, and Serial Nos. 176, 177, 179, 180, 181, 182, 185, 187, 192, 193, 195, 196, 197, 203, 208, 213, 218, 232, 238, 242, 262, and 339)

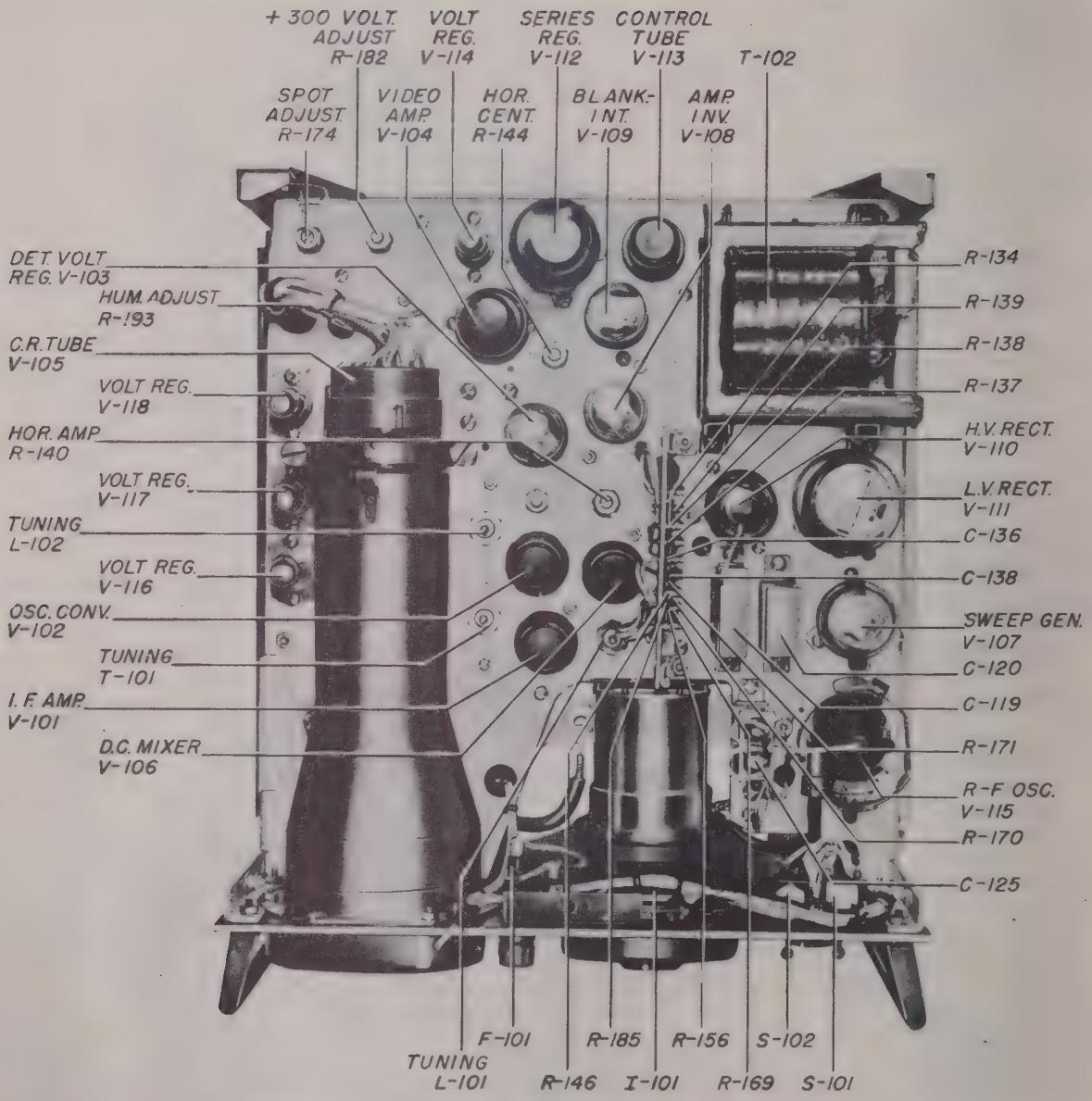
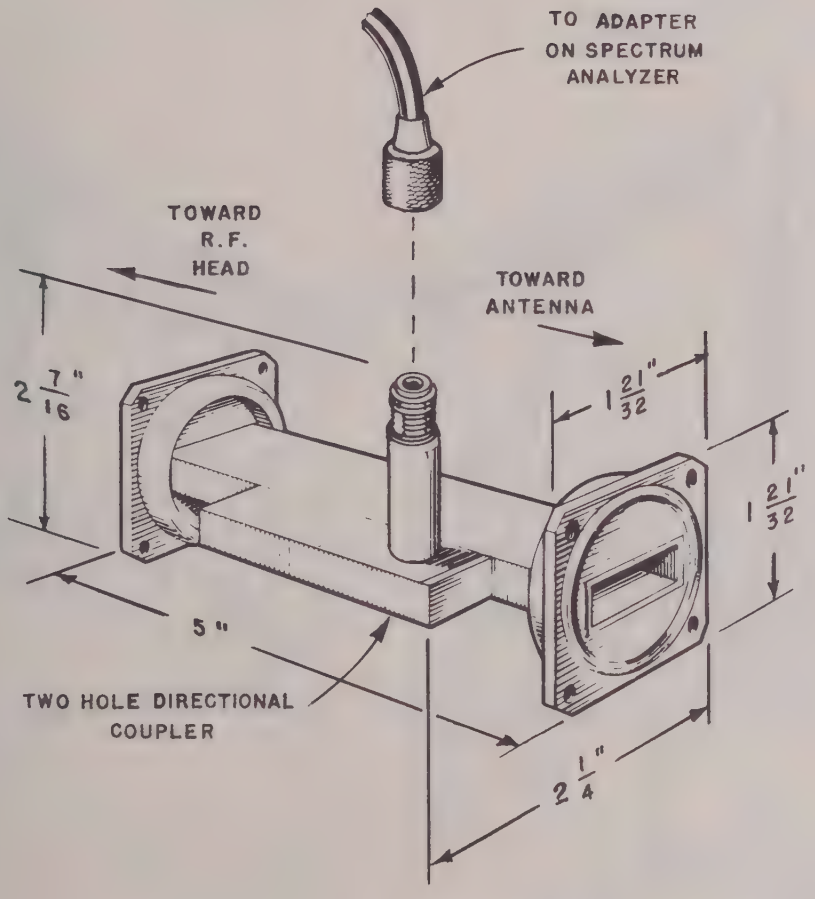


Figure 5-4. Spectrum Analyzer, Top View (Serial Nos. 175-817)



NAVY TYPE CG-176/AP

Figure 5-5. Directional Coupler CG-176/AP

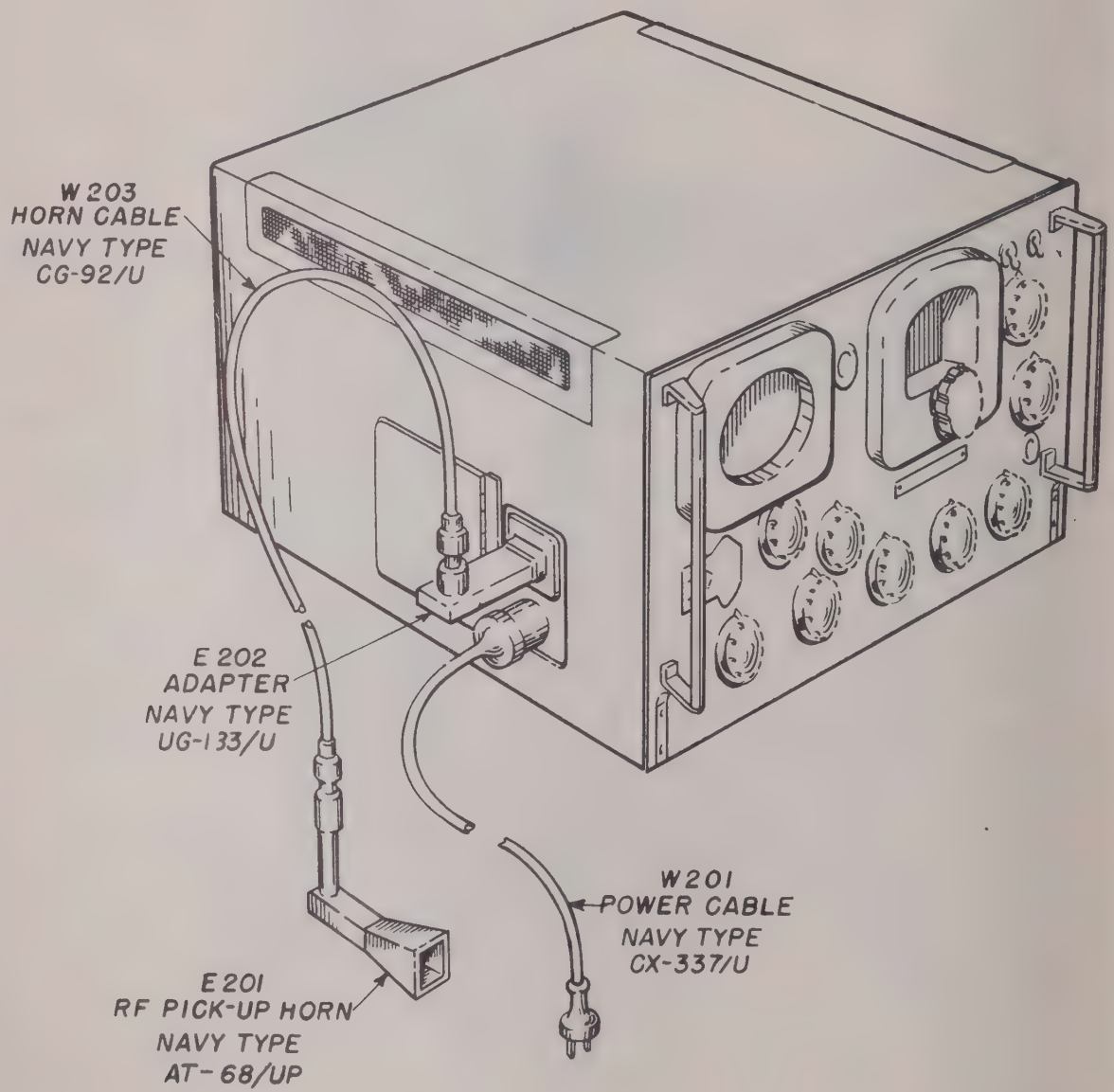


Figure 5-6. Spectrum Analyzer With Antenna Horn (Dwg. 7614118)

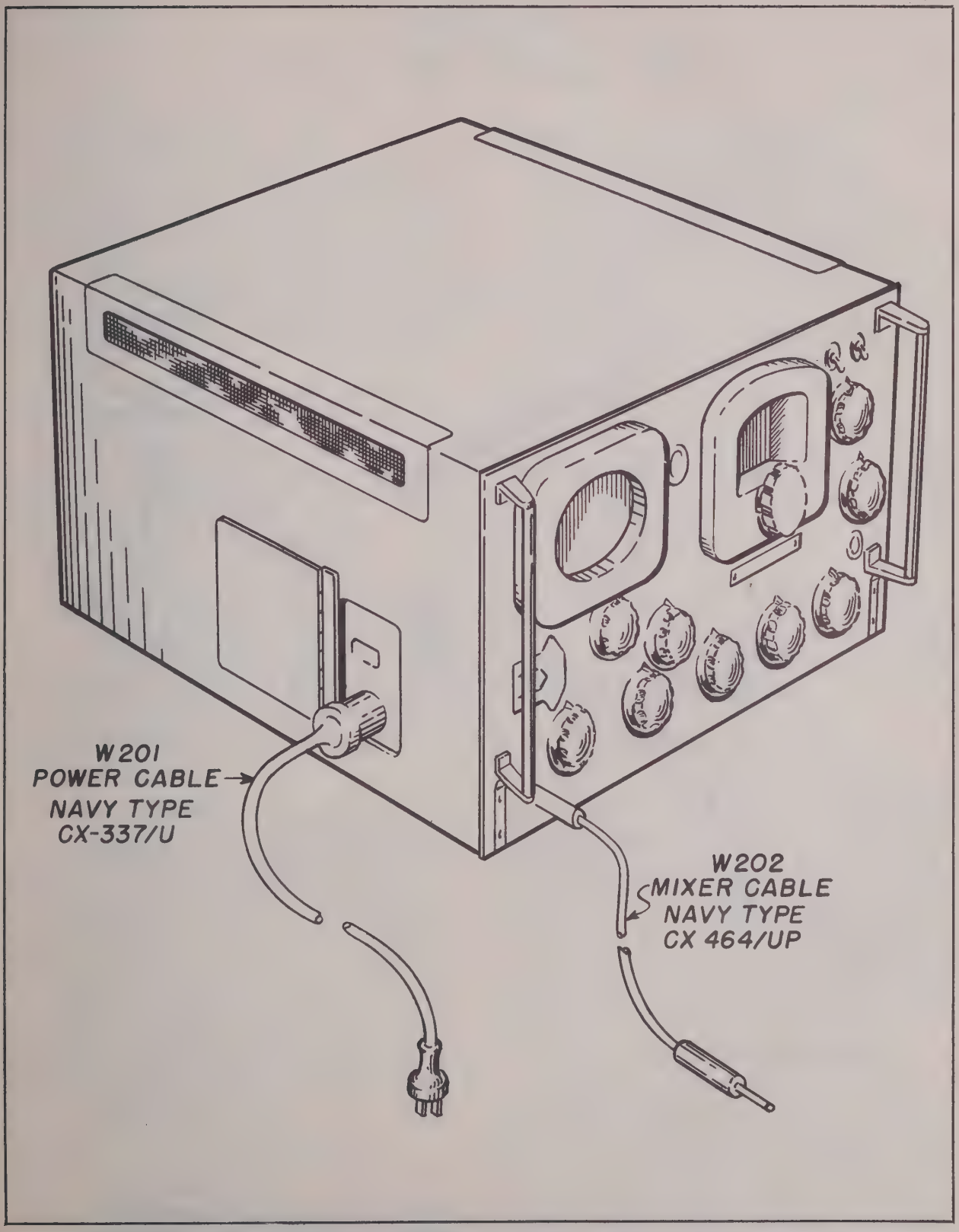


Figure 5-7. Spectrum Analyzer Set Up for Viewing Output of Radar Crystal Mixer (Dwg. 7614118)

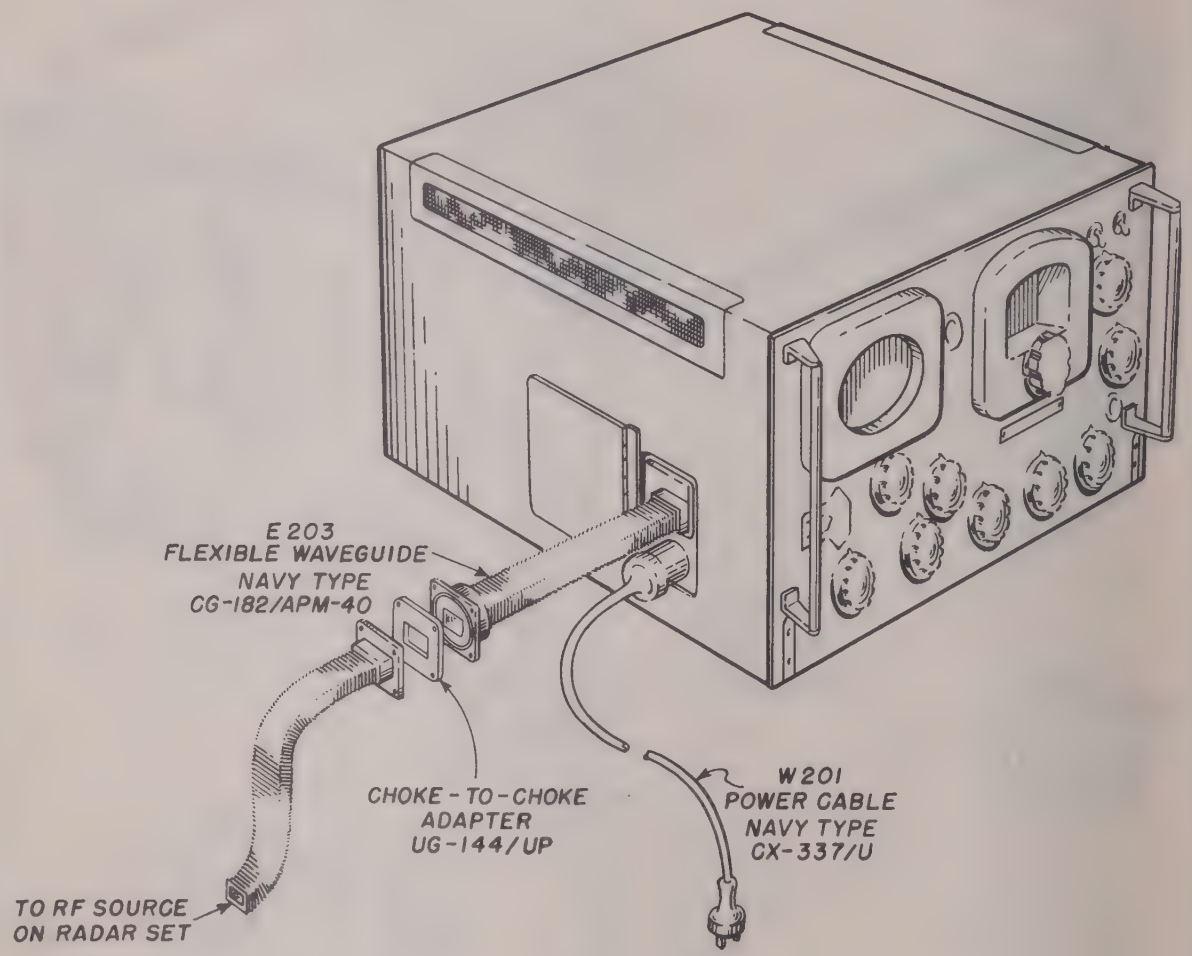


Figure 5-8. Spectrum Analyzer Set Up for Use With Flexible Wave Guide (Dwg. 7614118)

SECTION VI
TABLE OF REPLACEABLE PARTS

1. ARRANGEMENT OF THE TABLE.

a. Table 6-2 constitutes the major portion of this section and falls into one main division including the parts of both the one major unit and the accessories of the Spectrum Analyzer TS-148/UP.

b. The Table of Replaceable Parts is a combined list of replaceable parts used in equipments manufactured under the following contracts: NXsa-59108, N383s-1427 and N383s-45628. For Serial number sequences, see Table II, paragraph 4 *b.*

c. Each sheet of the table is divided vertically into six columns, which are labelled from left to right:

(1) "Reference Symbol".

(2) "ASO Stock Number", "USAF Stock Number", "Navy Type Number", and "SigC Stock Number".

(3) "Name of Part and Description".

(4) "Function".

(5) "Mfr. and Desig. or JAN or AWS Type".

(6) "Cont. or Govt. Dwg. or Spec. No.".

d. Paragraphs 2 through 7 below provide an explanation of each of these six columns. Paragraphs 8 and 9 respectively list the abbreviations used in the table and the names and addresses of the various manufacturers.

2. COLUMN 1: REFERENCE SYMBOLS.

a. A reference symbol—consisting of one or two uppercase letters, a hyphen, and three significant figures—is assigned to each electrical and mechanical component of the TS-148/UP equipment for which a replacement may be required or to which reference is made in the drawings and text of this handbook.

b. The alphabetical portion of each reference symbol indicates the particular category of electrical or mechanical component to which the symbol is assigned. The list below covers all categories of component found in the table of replaceable parts for the TS-148/UP equipment.

Designation	*Type of Component*
C	Capacitors of all types.
CR	Crystal, rectifier type.
E	Miscellaneous electrical parts: adapters, tube shields, wave guides, antenna horns, insulators, ground lug, etc.
F	Fuses.
H	Hardware: screws, bolts, knobs, etc.
I	Indicating lamps.
J	Jacks and receptacles.
L	Inductors: radio-frequency and audio-frequency.
O	Mechanical parts: shafts, plug sleeve.
P	Plugs.
R	Resistors: fixed and variable (potentiometers, etc.).
S	Switches.
T	Transformers: radio-frequency and power.
V	Vacuum and gaseous discharge tubes.
W	Wires and interconnecting cables.
X	Sockets.
Z	Impedance network

c. In the Table of Replaceable Parts, the components included are listed in alphabetical and numerical series of their reference symbols: C-101—C-142, CR-101, E-101—E-204, etc. The 201 series is used for the auxiliary equipment.

d. In some cases an item supplied on one or more of the contracts differs slightly from the item supplied on one or more of the other contracts. An item on which such a difference exists is indicated by one of the four signs listed in Paragraph 8 *a.*

3. COLUMN 2: STOCK NUMBERS.

a. Column 2 lists the ASO Stock Number, USAF Stock Number, Navy Type Number, and SigC Stock Number (in that order) of the applicable component. Navy type numbers are not shown for components which are identified by a JAN or AWS designation, AN nomenclature, or most AN aeronautical standard designations.

b. The hash mark or number sign (#) that occasionally appears in this column indicates that the applicable component is *not* supplied in the spare parts under *Contract N383s-1427, Serial Nos. 1001-1688.*

4. COLUMN 3: NAME AND DESCRIPTION.

a. This column gives the name and description of the component identified by reference in Column 1. The description, however, is given only for the first appearance of a given component. If it appears again (bearing a different reference symbol), Column 3 gives only the name and phrase "Same as ...." (reference symbol associated with the component's first appearance).

b. In instances where two descriptions are listed for the same component, the item differs slightly as supplied under the two contracts.

5. COLUMN 4: FUNCTION.

The electrical or mechanical function associated with each reference symbol is given in this column.

6. COLUMN 5: DESIGNATION.

a. This column lists the manufacturer and manufacturer's designation, or the JAN or AWS type designation, of the component for all contracts. Where the same supplier has been used by both contractors, the vendor's name and part number is shown centered opposite the name of both contractors.

7. COLUMN 6: PART/DWG. NUMBER.

This column contains one or more contractor's part-and-drawing number for the applicable component. Where applicable, JAN or AWS specifications are also listed in this column.

8. LIST OF SIGNS AND ABBREVIATIONS USED IN THE TABLE OF REPLACEABLE PARTS.

a. SIGNS.

*	Used on Contract NXsa-59108 only.
†	Used on Contract N383s-1427 only.
††	Used on Contract N383s-45628.
§	Used on Contracts N383s-1427 and N383s-45628.
#	appearing in column 2 indicates that component is not supplied in spares on Contract N383s-1427.
#	number(s)
%	per cent
±	plus or minus

b. ABBREVIATIONS.—The following list of abbreviations used in describing the various components in Column 3 conform to the "Joint Army-Navy Manual of Standard Descriptions", Specification JANP-109. ANA Bulletin 261 abbreviations have been used to describe the electrical or mechanical function of the various components.

Abbreviation	*Meaning*
AC	alternating current
AF	audio frequency
amp	ampere(s)
AN	Army-Navy
approx	approximate(ly)
assem	assembly
AWG	American wire gauge
AWS	American War Standard
BNC	a type of coaxial connector
c to c	center to center
coef	coefficient
cond	conductor(s)
cont	contact(s)
cps	cycles per second
CRS	cold rolled steel
cyc	cycle(s)
d	depth or deep
DC	direct current
deg	degree of angle
°C	degrees Centigrade
°F	degrees Fahrenheit
diam	diameter
dimen	dimensions
DPST	double pole single throw
dwg	drawing(s)
ea	each
ext	external
ft	foot(feet)
gnd	ground
h	high
hex	hexagonal
HF	high-frequency
HV	high-voltage
hy	henry(ies)
ID	inside diameter
IF	intermediate frequency
ins	insulator(s)
int	internal
JAN	Joint Army-Navy
lg	length or long
ma	milliampere(s)
max	maximum
mc	megacycle(s)
meg	megohm(s)
mh	millihenry(ies)
min	minimum, minute
mtd	mounted
mtg	mounting
mtg/c	mounting center(s)
mts	mounts
neg	negative
OD	outside diameter
osc	oscillator
pl	plated
pri	primary(ies)
RF	radio frequency
RMS	root mean square
rpm	revolutions per minute
secd	secondary
sect	section(s)
spec	specification(s)
SPST	single pole single throw
sq	square
std	standard
temp	temperature
term	terminal(s)
thd	thread(s)
thk	thick
v	volt(s) or voltage
vdcw	DC working voltage
w	watt(s)
w/	with
wd	wide or width
x	by
μf	microfarad(s)
μμf	micro-microfarad(s)
μh	micro-henry(ies)

9. LIST OF MANUFACTURERS.

The names and addresses of manufacturers of replaceable parts are listed below in table 6-1 together with the abbreviation for each manufacturer as used in the Table of Replaceable Parts. The code designation for each manufacturer which is used as a prefix in Navy Type Numbers is also listed.

TABLE 6-1. LIST OF MANUFACTURERS

Abbreviations	*Navy Type No.*	*Name and Address*
AB	CBZ	Allen-Bradley Co. Milwaukee 4, Wisconsin
Aerovox	CAW	Aerovox Corporation New Bedford, Mass.
Airtron	CBHF	Airtron, Inc. 650 Bloomingdale Rd. Staten Is. 9, N. Y.
Alden	CYA	Alden Products Co. Brockton, Mass.
Allen	CAYT	The Allen Mfg. Co. Hartford 1, Conn.
Amphenol	CPH	American Phenolic Corp. 1830 So. 54th Avenue Chicago 50, Illinois
Amer Rad Hdwe	CMH	American Radio Hardware Co. 476 Bwy., N. Y. C., N. Y.
Anaconda	CAUU	Anaconda Wire & Cable Co. 25 Bwy., N. Y. C., N. Y.
Atlan India Rub	——	Atlantic India Rubber Co. 1453 W. Van Buren Street Chicago, Illinois
Barry Corp	——	The Barry Corporation 233 Bwy., N. Y. C., N. Y.
Belden	CQG	Belden Mfg. Co. Chicago, Illinois
Bryant Elec	CYD	Bryant Electric Co Bridgeport, Conn.
Buss	CFA	Bussman Mfg. Co. St. Louis, Mo.
Centralab	CBN	Centralab Milwaukee, Wisc.
Cinch	CMG	Cinch Mfg. Co. 2339 W. Van Buren Street Chicago, Illinois
Concarbon	CC	Continental Carbon Co. Cleveland, Ohio
Crystal Plastics	——	Crystal Plastics, Inc. 232 Taaf Pl., Brooklyn, N. Y.
Vitalic	——	Continental Rubber Works Erie, Penna.
Dubilier	CD	Cornell-Dubilier Elec. Corp. So. Plainfield, New Jersey
C-H	CAE	Cutler-Hammer, Inc. Milwaukee, Wisc.
DuPont	——	DuPont, E. I. De Nemours & Co., Inc., Wilmington, Del.
Elec React	——	Electrical Reactance Corp. Franklinville, New York
Electro Motive	CMF	Electro-Motive Mfg. Co. Willimantic, Conn.
Erie	CER	Erie Resistor Co. Erie, Penna.
Fed Tel Rad	CFT	Federal Telephone & Radio Corp. 200 Mt. Pleasant Avenue Newark, New Jersey
Franklin, AW	CFK	AW Franklin Mfg. 175 Varick St., N. Y. C., N. Y.
Freed Trans	CFX	Freed Transformer Co. 72 Spring St., N. Y. C., N. Y.
GE	CG	General Electric Co. Schenectady, New York
Guarantee Spec	——	Guarantee Specialty Co. 60 Lispenard St., N. Y. C., N. Y.
Hanovia Chem	CAEK	Hanovia Chemical Mfg. Co. Newark, New Jersey
Hazeltine Elec	CHZ	Hazeltine Electronics Corp Little Neck, L. I., N. Y.
Ind Prod	CARO	Industrial Products Co. Danbury, Conn.
IRC	CIR	International Resistance Co. Philadelphia, Penna.
Isolantite	CBU	Isolantite, Inc. 233 Bwy., N. Y. C., N. Y.
Insuline Corp	CAXD	Insuline Corp. of America 30-30 No. Blvd., L. I. C., N. Y.
Kurz-Kash	CAUP	Kurz-Kash, Inc. Dayton 1, Ohio
Littelfuse	CLF	Littelfuse Laboratories, Inc. Chicago, Illinois
LO-Man Mfg	——	LO-Man Mfg. Inc. 405-44 St., Brooklyn, N. Y.
MacKenzie Prod	——	MacKenzie Products New Haven, Conn.
Maguire Ind	CUO	Maguire Industries Greenwich, Conn.
Mallory	CMA	Mallory, P. R. & Co., Inc. Indianapolis 6, Indiana
Mendelsohn Gun	CIU	Mendelsohn Speed Gun Co. 457-461 Bloomfield Avenue Bloomfield, New Jersey
Micamold	CMR	Micamold Radio Corp. 1087 Flushing Avenue Brooklyn, N. Y.
Millen	CJA	James Millen Mfg. Co. Malden, Mass.

Abbreviations	*Navy Type No.*	*Name and Address*
Molded Insul	CMI	Molded Insulation Co., Inc. Philadelphia, Penna.
Muter	CAKD	Muter Company 1255 S. Michigan Avenue Chicago, Illinois
Natl Ceramic	CNP	National Ceramic Co. Trenton, New Jersey
Natl Co	CNA	National Company, Inc. Malden, Mass.
Noma Elec	CNB	Noma Electric Corp. 55 W. 13th St., N. Y. C., N. Y.
Parker-Kalon	——	Parker-Kalon Corp. New York 14, N. Y.
Pierce Rob	——	Pierce-Roberts Company Trenton, New Jersey
Plume & Atwood	——	Plume & Atwood 550 Bank Street Waterbury, Conn.
RCA	CRC	RCA Mfg. Co. Camden, New Jersey
Rubber Miller	——	709 S. Canton Avenue Baltimore, Md.
Sangamo	CAN	Sangamo Electric Co. Springfield, Ill.
Smith SB	——	S. B. Smith Company 193-16 99th Avenue Hollis, L. I., N. Y.
Sickles	CFW	Sickles Co., F. W. Springfield, Mass.
Solar	CSL	Solar Mfg. Co. Bayonne, New Jersey
Speer	CPQ	Speer Resistor Company St. Mary's, Penna.
Sperry Gyro	CS	Sperry Gyroscope Co., Inc. Great Neck, L. I., N. Y.
Sprague Spec	CSF	Sprague Specialties Co. North Adams, Mass.
Stackpole	CSA	Stackpole Carbon Co. St. Mary's, Penna.
State Bolt	SBOC	State Bolt & Screw Co. 71 Murray St., N. Y. C., N. Y.
Steiner	——	Steiner Mfg. Co. 4730 33rd Street Long Island City, N. Y.
Suffolk Prod	CBKK	Suffolk Products, Inc. Northport, L. I., N. Y.
Sylvania	CHS	Sylvania Electric Prod. Inc. Emporium, Penna.
Telephonics	CTE	Telephonics Corp. 350 W. 31st St., N. Y. C., N. Y.
Titeflex	CBHH	Titeflex, Inc. Newark, New Jersey
Tobe	CTD	Tobe-Deutschman Corp. Canton, Mass.
Waterfield	CADY	Waterfield, J. B. Co. Box 452, Attleboro, Mass.
WECo	CW	Western Electric Co. Kearny, N. J.
Wemco	CAY	Westinghouse Elec. Mfg. Co. Baltimore, Md.
Wilmar Prod	——	Wilmer Products, Inc. Harrison Ave., Roseland, N. J.
Zierick	——	Zierick Mfg. Co. 385 Gerard Ave., N. Y. C., N. Y.

10. ORDERING OF SPARE PARTS.

a. Each Service using this list has established certain depots and service groups for the storage and issue of spare parts of its organizations requiring them. The regulations of each Service should be studied to determine the method and source for requisitioning spare parts. The information in this list, as to manufacturer's or contractor's name, type, model or drawing number, is not to be interpreted as authorization to field agencies to attempt to purchase identical or comparable spare parts direct from the manufacturer or a wholesale or retail store except under emergency conditions as covered by existing regulations of the Service concerned.

b. AIR FORCE PERSONNEL: This table is for information ONLY and is not to be used as a basis for requisitioning parts. Authorities for obtaining maintenance items are as follows: 1. For using organizations: applicable Service publications of the 00–30 series of AAF Technical Orders. 2. For higher maintenance and supply echelons: the applicable Standard Maintenance List.

c. Where no JAN or Navy standard part number is given to a component, care should be taken in replacing the component with any other part than that listed in the Table of Replaceable Parts. This special part probably has been chosen for a special quality not available in standard components, and use of a standard component may result in decreased life or lowered performance.

11. RESISTOR AND CAPACITOR COLOR CODES.

The resistors and capacitors covered by JAN specifications are readily identified by "type designations" which are a coded combination of letters and numbers indicating the principal physical and electrical characteristics of a component, so that personnel familiar with the code of these type designations know

immediately, for example, if a resistor is composition or wire wound, its power rating, its value, tolerance, etc. The type designation should appear on the component for visual inspection. However, in the case of fixed composition resistors, ceramic and mica capacitors, it is difficult to inscribe the designation because of the limited space available. For this reason a color code system has been devised, using circular bands for fixed composition resistors and ceramic capacitors, and colored dots for mica capacitors.

Explanations of the standard color codes and of the designations for composition resistors per Spec. JAN-R-11, mica capacitors per Spec. JAN-C-5, ceramic capacitors per Spec. JAN-C-20 are given below in Paragraphs 11*a*; 11*b*; and 11*c*.

a. Fixed Composition Resistors.

(1) Type Designation.—The type designation of fixed composition resistors furnished in accordance with Spec. JAN-R-11 shall be in the following form:

RC 21 BF 103 K

Component Style Characteristic Resistance Tolerance

(*a*) *Component.*—Fixed composition resistors covered by Spec. JAN-R-11 are identified by the symbol "RC".

(*b*) *Style.*—The style is a two-digit symbol and identifies a resistor of a particular power rating, shape, and size.

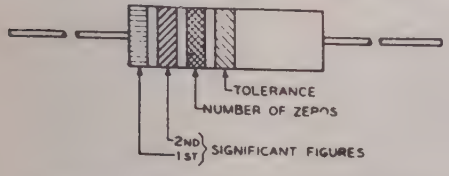
(*c*) *Characteristic.*—The characteristic is a two-letter symbol identifying the characteristics of fixed composition resistors. The first letter denotes the element insulation and moisture resistance. The second letter denotes the resistance temperature characteristic.

(*d*) *Resistance.*—The nominal resistance value in ohms is identified by a three-digit symbol. The first two digits are the first two figures of the resistance value in ohms. The final digit specifies the number of zeros which follow the first two figures.

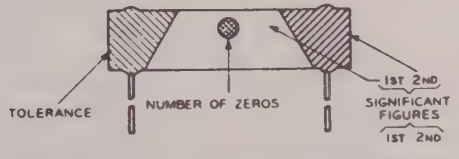
(*e*) *Resistance Tolerance.*—The symmetrical resistance tolerance in percent is denoted by letters "J ±5%", "K ±10%, and "M ±20%".

(2) Color Code.

COLOR CODE FOR FIXED RESISTORS-VALUES IN OHMS



Resistor with axial wire leads.



Resistor with radial wire leads.

BODY		END		DOT OR BAND		END	
1st Band		2nd Band		3rd Band		End Band	
Color	Value	Color	Value	Color	Value	Color	Tolerance
Black	0	Black	0	Black	None	Gold	± 5%
Brown	1	Brown	1	Brown	0	Silver	±10%
Red	2	Red	2	Red	00	None	±20%
Orange	3	Orange	3	Orange	000		
Yellow	4	Yellow	4	Yellow	0000		
Green	5	Green	5	Green	00000		
Blue	6	Blue	6	Blue	000000		
Violet	7	Violet	7	Violet	0000000		
Grey	8	Grey	8	Grey	00000000		
White	9	White	9	White	000000000		

EXAMPLE FOR AXIAL-LEAD RESISTOR

Band	Color	Significant Figures		Number of Zeros	Tolerance
		1st	2nd		
1	red	2	...	...	...
2	orange	...	3	...	...
3	yellow	...	...	0000	...
4	gold	...	...	...	±5%

The resistance of this resistor is 230,000 ohms ±5%.

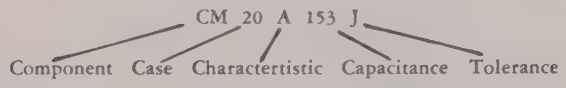
EXAMPLE FOR RADIAL-LEAD RESISTOR

Position	Color	Significant Figures		Number of Zeros	Tolerance
		1st	2nd		
body	orange	3	...	...	...
end	blue	...	6	...	...
dot	green	...	...	00000	...
end	silver	...	...	...	±10%

The resistance of this resistor is 3,600,000 ohms ±10%

b. Fixed Mica Capacitors.

(1) Type Designation.—The type designation for fixed mica-dielectric capacitors furnished in accorddance with Spec. JAN-C-5 shall be in the following form:



(*a*) *Component Designation.*—Fixed mica-dielectric capacitors are identified by the symbol "CM".

(*b*) *Case Designation.*—The case designation is a two-digit symbol which identifies a particular case size and shape.

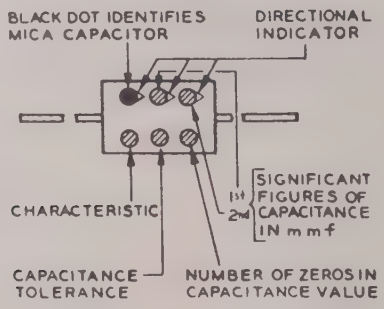
(*c*) *Characteristic.*—The characteristic is identified by a single letter which denotes temperature coefficient part/million/degrees C.

(*d*) *Capacitance Value.*—The nominal capacitance value in micro-microfarads is identified by a three-digit number. The first two digits are the first two digits of the capacitance value in micro-microfarads. The final digit specifies the number of zeros which follow the first two digits. Where more than two significant figures are required, additional digits may be used, the last digit always indicating the number of zeros.

(*e*) *Capacitance Tolerance.*—The symmetrical capacitance tolerance in percent is designated by letter "G ±2%, "J ±5%", "K ±10%", and "M ±20%".

(2) Color Code.

COLOR CODE FOR JAN FIXED MICA CAPACITORS



Color code scheme for JAN standard fixed mica capacitors. The significance of the letters denoting "characteristic" will be found in the Joint Army-Navy Specification JAN-C-5.

Color	CAPACITANCE		Tolerance	Characteristic
	Significant Figure	Decimal Multiplier		
Black	0	1	20 per cent (M)	A
Brown	1	10	.....	B
Red	2	100	2 per cent (G)	C
Orange	3	1,000	.....	D
Yellow	4	..	.....	E
Green	5	...	.....	F
Blue	6	...	.....	G
Violet	7	...	.....	
Gray	8	...	.....	
White	9	..	.....	
Gold	...	0.1	5 per cent (J)	...
Silver	...	0.01	10 per cent (K)	...

c. Fixed Ceramic Capacitors.

(1) Type Designation.—The type designation of fixed ceramic capacitors furnished in accordance with Spec. JAN-C-20 is formed as follows:

CC 21 SL 390 J

Component — Style — Characteristic — Capacitance — Capacitance Tolerance

(*a*) *Component Designation.*—Fixed ceramic capacitors are identified by the symbol "CC".

(*b*) *Style.*—The style designation is a two-digit symbol which identifies a particular shape and size.

(*c*) *Characteristics.*—The characteristic designation is in the form of two letters. The first letter specifies the temperature coefficient of capacitance. The second letter indicates the positive and negative tolerance on the temperature coefficient of capacitance.

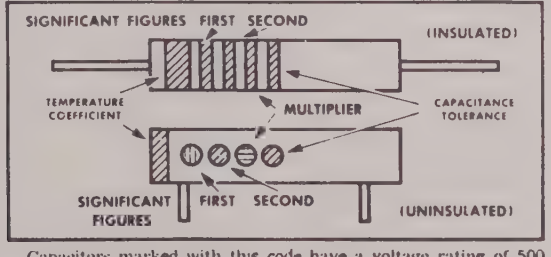
(*d*) *Capacitance Value.*—The nominal capacitance value in micro-microfarads is identified by a three-digit number. The first two digits are the first two digits of the capacitance value in micro-microfarads. The final digit specifies the number of zeros which follow the first two digits. When more than two significant figures are required, additional digits may be used, the last digit always indicating the number of zeros. If the capacitance value is expressed as a decimal fraction, the decimal point shall be indicated by an "R", and there shall be no indication of a number of zeros to follow the significant figures. Thus, 1R5 indicates 1.5 micro-microfarads.

(*e*) *Capacitance Tolerance.*—The symmetrical capacitance tolerance in percent is designated by letter.

C	0.25 $\mu\mu$f
D	.5 $\mu\mu$f
F	1%
G	2%
J	5%
K	10%
M	20%

Where the nominal value of capacitance is greater than 10 micro-microfarads or smaller, the tolerance shall be expressed in micro-microfarads.

JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS



Capacitors marked with this code have a voltage rating of 500 volts. Either the band or dot code may be used.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER
		JAN CERAMIC-DIELECTRIC
BLACK	0	1
BROWN	1	10
RED	2	100
ORANGE	3	1,000
YELLOW	4	
GREEN	5	
BLUE	6	
VIOLET	7	
GRAY	8	0.01
WHITE	9	0.1
GOLD		
SILVER		
NO COLOR		

TABLE 6-2. TABLE OF REPLACEABLE PARTS

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
101-299 Series	#R16-AN-TS-148/UP —	ANALYZER, SPECTRUM: Army-Navy Spectrum Analyzer Type TS-148/UP, range 8470 to 9630 mc, 1 band; ±5 mc accuracy; cathode-ray tube indicator, displays frequency components as power plotted against frequency; waveguide RG-52/U input; AC power input, 105-125 v, 50-1200 cycles, single phase, 125 watts; over-all dim. 18 in. lg, 15 11/16 in wide, 9 1/8 in high; portable type; accessories include one Army-Navy Carrying case Type #CY-246/U, one Army-Navy Auxiliary and spare parts box Type CY-245/U, one Army-Navy Mounting Base Type MT-325/U, one Army-Navy R.F. cable Type CG-92A/U, one Army-Navy Power cable Type CX-337/U, one Army-Navy Mixer cable Type CX-464/UP, one Army-Navy Flexible waveguide Type CG-182/APM, one Army-Navy Pickup horn Type AT-68/UP, one Army-Navy Directional coupler Type CG-176/AP, one Army-Navy Adaptor, choke Type UG-144/AP, one Army-Navy Adaptor coax to waveguide Type UG-183/U, 6 power-supply fuses, 2 type 1N23A xtals, 4 pilot light lamps; Hazeltine Elec (mfr) Part/Dwg #A-4014; designed to display the components of radio-frequency signals; may be used as a frequency meter and as a signal generator.		Hazeltine Elec A-4014	Wemco DL-7502890 G-1 Hazeltine Elec A-4014 BuAer Spec 16A46 (Aer)
		ANALYZER, SPECTRUM: Part of Army-Navy Spectrum Analyzer TS-148/UP, range 8470 to 9630 mc, 1 band; ±5 mc accuracy; cathode-ray tube indicator, displays frequency components as power plotted against frequency; waveguide RG-52/U input; AC power input, 105-125 v, 50-1200 cycles, single phase, 125 watts; over-all dim. 13″ lg, 11.875 in wide, 8 19/32″ high; portable type; Hazeltine Elec (mfr) Part/Dwg #A-4007; designed to display the components of radio-frequency signals; may be used as a frequency meter and as a signal generator.		Hazeltine Elec A-4007	Hazeltine Elec A-4007 BuAer Spec 16A46 (Aer)
A-101		CASE: Carrying Case CY-246/U; transit case for Spectrum Analyzer TS-148/UP and accessories; aluminum interior clear lacquer finish, exterior Condur dark gray E finish; empty; 25″ lg x 13″ wd x 19 1/4″ h approx o/a; 2 compartments, one approx 8″ wd x 9 1/2″ lg x 16 1/2″ d, second 15 1/16″ lg x 11 1/2″ wd x 16 1/2″ d o/a; 2 folding handles, 1 ea end; hinged cover held by hooks and latches w/sealing gasket all around, also 2 bumpers to hold case contents; (incl H-126, H-127, H-128, H-129, H-130, O-116, O-117, O-120).	Transit case for Spectrum Analyzer and accessories	Hazeltine Elec A-14128	Hazeltine Elec A-14128 BuAer Spec 16A46 (Aer)
A-102		MOUNTING: aluminum; clear lacquer; mounts equipment by 2 aligning pins and 2 thumb nuts; 20 mtg holes #10-32, located by pairs 3.625″ c to c, 8 on ea end, and 4 on bottom to mount rubber pads, also 10 rubber pads not furnished w/Mounting Base; provides mounting for spectrum analyzer; (incl H-109, O-114).	Mounts Spectrum Analyzer in case A-101	Hazeltine Elec A-4017	Hazeltine Elec A-4017 BuAer Spec 16A46 (Aer)

A-103		CASE: Auxiliary and Spare Parts Box CY-245/U; for accessories; aluminum, interior surfaces clear lacquer, exterior surface caustic dip gray E finish; empty; 16 3/8″ d x 7 1/4″ wd x 10 1/16″ lg o/a; mounts in carrying case by four snap fasteners, stud holes 0.359″ diam, ctb to 0.422″ diam on 5.250″ x 9.562″ mtg/c; 2 compartments, one 15 5/8″ lg x 6 15/16″ wd x 3 1/2″ h, second 16 3/16″ lg x 7 1/16″ wd x 4 5/8″ h approx o/a; single U-type handle on 1 end; 2 doors, 1 on front, 1 on top.	Accessories and stand-by spares	Hazeltine Elec A-3996	Hazeltine Elec A-3996 BuAer Spec 16A46 (Aer)
A-104		MOUNTING: aluminum alloy; caustic dip; holds switch by means of 0.515″ diam shaft mtg hole; three #8-32 x 1/2″ d mtg holes spaced 5/8″ and 13/16″ at 90 deg, located on base at opposite end of shaft hole for mounting rotary switch.	Mounts video selectors on S-103	Hazeltine Elec DC-1057	Hazeltine Elec DC-1057
C-101	#R16-C-10084-7 3300-376 049 400 #— 3K2510211	CAPACITOR, fixed: mica 1000 μμf ±10%; 500 vdcw.	I-f input transf r-f bypass	JAN type CM25A102K	Spec JAN-C-5 Wemco 7613282 P-1 Hazeltine Elec CM25A102K
C-102		CAPACITOR, fixed: 1000 μμf ±10%; same as C-101.	I-f input transf bypass		
C-103		CAPACITOR, fixed: 1000 μμf ±10%; same as C-101.	I-f bias filter		
C-104		CAPACITOR, fixed: 1000 μμf ±10%; same as C-101.	1st i-f screen bypass		
C-105	#R16-C-9924-56-500 #3300-376 002 800 #— #3K2010132	CAPACITOR, fixed: mica; 100 μμf ±5%; 500 vdcw.	Grid coupling converter	JAN type CM20C101J	Spec JAN-C-5 Wemco 7613282 P-5 Hazeltine Elec CM20C101J
C-106	#R16-C-7776-850 3300-313 004 906 #— 3D9010-123	CAPACITOR, fixed: ceramic; 10 μμf ±0.5 μμf; 500 vdcw.	Converter osc tuning	JAN type CC21HH100D	Spec JAN-C-20 Wemco 7613282 P-6 Hazeltine Elec CC21HH100D
C-107		CAPACITOR, fixed: 100 μμf ±5%; same as C-105.	Converter osc grid coupling		
C-108	#R16-C-10493 #3300-376 143 900 #— #3K3510311	CAPACITOR, fixed: mica; 10,000 μμf ±10%; 300 vdcw.	Converter screen bypass	JAN type CM35A103K	Spec JAN-C-5 Wemco 7613282 P-8 Hazeltine Elec CM35A103K

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
C-109		CAPACITOR, fixed: 10,000 μμf ±10%; same as C-108.	Converter supply bypass		
C-110		CAPACITOR, fixed: 100 μμf ±5%; same as C-105.	Detector grid coupling		
C-111		CAPACITOR, fixed: 100 μμf ±5%; same as C-105.	Detector cathode bypass		
C-112		CAPACITOR, fixed: 1000 μμf ±10%; same as C-101.	Detector pl bypass		
C-113		CAPACITOR, fixed: 10 μμf ±0.5 μμf; same as C-106.	Converter pl tuning		
C-114	#R16-C-9809-23 #3300-376 007 200 # — #3K2015021	CAPACITOR, fixed: mica; 15 μμf ±10%; 500 vdcw.	Video pip coupling	JAN type CM20B150K	Spec JAN-C-5 Wemco 7613282 P-14 Hazeltine Elec CM20B150K
C-115*†	#R16-C-11336-45-800 3300-317 760 004 # — 3DA100-779	CAPACITOR, fixed: paper-dielectric; three sect; 100,000 μμf +20% −10% ea sect; 400 vdcw; hermetically sealed non-magnetic metal case; 1½″ lg x 1¾″ wd x 41/64″ thk, less term; oil filled; 3 solder lug term ¾″ h max, ½″ c to c; internal ground connection; two 0.144″ diam mtg holes in bracket 2⅛″ c to c.	Includes C-115A, C-115B, C-115C	AWS type CP67B5EE104MK Can be replaced by JAN type CP67B5EF104V	Spec AWS C75.16 Wemco 7613282 P-15 Hazeltine Elec CO-1195 Spec JAN-C-25
C-115††		CAPACITOR, fixed: paper-dielectric, three sect; 100,000 μμf +20% −10% ea sect; 600 vdcw; int gnd connection.	Includes C-115A, C-115B, C115C	JAN type CP67B5EF104V	Spec JAN-C-25 Hazeltine Elec CP67B5EF104V
C-115*†		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-115*†.	Spot adjustment bypass		
C-115A††		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-115††.	Spot adjustment bypass		
C-115B*†		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-115*†.	R-f bypass		
C-115B††		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-115††.	R-f bypass		
C-115C*†		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-115*†.	Sweep gen bias filter		

C-115C††		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-115††.	Sweep gen bias filter		
C-116*†	#R16-C-11485-300 3300-317 094 999 #— 3DB2-159	CAPACITOR, fixed: paper-dielectric 2μf +20% −10%; 400 vdcw; hermetically sealed non-magnetic metal case; 2″ lg x 2″ wd x 1¼″ h, less term; oil filled; 2 solder lug term ¾″ h max, 1″ c to c; no internal ground connection; 2 mtg tabs w/3/16″ diam holes on 2⅜″ mtg/c.	Detector bias filter	AWS type CP51B1EE205MK Can be replaced by JAN type CP54B1EF205V	Spec AWS C75.16 Wemco 7613282 P-18 Hazeltine Elec CO-1169 Spec JAN-C-25
C-116††		CAPACITOR, fixed: paper-dielectric 2μf +20% −10% 600 vdcw; no internal ground connection.	Detector bias filter	JAN type CP54B1EF205V	Spec JAN-C-25 Hazeltine Elec CP54B1EF205V
C-117*†	#R16-C-11333-118 3300-317 760 007 #— 3DA100-782	CAPACITOR, fixed: paper-dielectric; two sect; 100,000 μμf ±10% ea sect; 1000 vdcw; hermetically sealed non-magnetic metal case; 1 13/16″ lg x 1″ wd x ⅞″ h, less term; oil filled; 3 solder lug term ¾″ h max, ½″ c to c; no internal ground connection; 2 mtg tabs w/3/16″ diam holes on 2⅛″ mtg/c.	Includes C-117A, C-117B	AWS type CP50B4AG104KK Can be replaced by JAN type CP53B4EG104V	Spec AWS C75.16 Wemco 7613282 P-19 Hazeltine Elec CO-1194 Spec JAN-C-25
C-117††		CAPACITOR, fixed: paper-dielectric, two sect; 100,000 μμf +20% −10% ea sect; 1000 vdcw; no int ground connection.	Includes C-117A, C-117B	JAN type CP53B4EG104V	Spec JAN-C-25 Hazeltine Elec CP53B4EG104V
C-117A*†		CAPACITOR, fixed: 100,000 μμf ±10%; part of C-117*†.	CRT intensifier grid filter		
C-117A††		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-117††.	CRT intensifier grid filter		
C-117B*†		CAPACITOR, fixed: 100,000 μμf ±10%; part of C-117*†.	CRT focusing anode filter		
C-117B††		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-117††.	CRT focusing anode filter		
C-118		CAPACITOR, fixed: 1000 μμf ±10%; same as C-101.	I-f filament bypass		
C-119*†	#R16-C-11336-45-500 3300-317 760 005 #— 3DA100-780	CAPACITOR, fixed: paper-dielectric; three sect; 100,000 μμf +20% −10% ea sect; 400 vdcw; hermetically sealed non-magnetic metal case; 1½″ lg x 1¾″ wd x 41/64″ thk, less term; oil filled; 3 solder lug term ¾″ h max, ½″ c to c; internal ground connection; two 0.144″ diam mtg holes in bracket 2⅛″ c to c.	Includes C-119A, C-119B, C-119C	AWS type CP69B5EE104MK Can be replaced by JAN type CP69B5EF104V	Spec AWS C75.16 Wemco 7613282 P-22 Hazeltine Elec CO-1204 Spec JAN-C-25

CONTRACT: *NXsa-59108. †N383s-1427. ††N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
C-119††		CAPACITOR, fixed: paper-dielectric, three sect; 100,000 μμf +20% −10% ea sect; 600 vdcw; internal ground connection.	Includes C-119A, C-119B, C-119C	JAN type CP69B5EF104V	Spec JAN-C-25 Hazeltine Elec CP69B5EF104V
C-119A*†		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-119*†.	Blanking tube bias filter		
C-119A††		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-119††.	Blanking tube bias filter		
C-119B*†		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-119*†.	Sweep gen bias filter		
C-119B††		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-119††.	Sweep gen bias filter		
C-119C*†		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-119*†.	Sweep amplifier inverter bias filter		
C-119C††		CAPACITOR, fixed: 100,000 μμf +20% −10%; part of C-119††.	Sweep amplifier inverter bias filter		
C-120*†	#R16-C-11354-26 3300-317 760 006 # — 3DA500-581	CAPACITOR, fixed: paper-dielectric; 500,000 μμf ±10%; 600 vdcw; hermetically sealed non-magnetic metal case; 2″ lg x 1 5/16″ wd x 49/64″ thk, less term; oil filled; 2 solder lug term 3/4″ h max, 5/8″ c to c; no internal ground connection; two 0.144″ diam mtg holes in bracket 1 15/16″ c to c.	Sweep gen freq	AWS type CP65B1EF504KK Can be replaced by JAN type CP65B1EF504K	Spec AWS C75.16 Wemco 7613282 P-25 Hazeltine Elec CO-1203 Spec JAN-C-25
C-120††		CAPACITOR, fixed: paper-dielectric; 500,000 μμf ±10%; 600 vdcw; no internal ground connection.	Sweep gen freq	JAN type CP65B1EF504K	Spec JAN-C-25 Hazeltine Elec CP65B1EF504K
C-121*†	#R16-C-11325 3300-317 760 015 # — 3DA100-790	CAPACITOR, fixed paper-dielectric; 100,000 μμf +20% −10%; 1000 vdcw; hermetically sealed non-magnetic metal case; 1 13/16″ lg x 1″ wd x 3/4″ h, less term; oil filled; 2 solder lug term 3/4″ h max, 1″ c to c; no internal ground connections; 2 mtg tabs w/ 3/16″ diam holes in ea on 2 1/8″ centers.	Focus pulse coupling	AWS type CP50B1AG104MK Can be replaced by JAN type CP53B1EG104V	Spec AWS C75.16 Wemco 7613282 P-27 Hazeltine Elec CO-1202 Spec JAN-C-25

C-121††		CAPACITOR, fixed: paper-dielectric, 100,000 μμf +20% −10%; 1000 vdcw; no internal ground connections.	Focus pulse coupling	JAN type CP53B1EG104V	Spec JAN-C-25 Hazeltine Elec CP53B1EG104V
C-122*†	#R16-C-11311-800 3300-317.760 003 #— 3DA100-778	CAPACITOR, fixed: paper-dielectric; 100,000 μμf +20% −10%; 600 vdcw; hermetically sealed non-magnetic metal case; 1 5/8″ lg x 1 5/16″ wd x 49/64″ thk, less term; oil filled; 2 solder lug term 3/4″ h max, 5/8″ c to c; no internal ground connection; two 0.144″ diam mtg holes in bracket 1 15/16″ c to c.	Sweep coupling	AWS type CP65B1AF104MK Can be replaced by JAN type CP65B1EF104V	Spec AWS C75.16 Wemco 7613282 P-30 Hazeltine Elec CO-1201 Spec JAN-C-25
C-122††		CAPACITOR, fixed: paper-dielectric, 100,000 μμf +20% −10%; 600 vdcw; no internal ground connection.	Sweep coupling	JAN type CP65B1EF104V	Spec JAN-C-25 Hazeltine Elec CP65B1EF104V
C-123*		CAPACITOR, fixed: paper-dielectric, oil filled, 100,000 μμf +20% −10%; 600 vdcw; metal case 1 1/16″ x 1 3/4″ x 9/16″, with two mounting feet; two terminals on bottom.	Sweep amplifier inverter coupling	AWS type CP69B1EF104MK	Spec AWS C75.16 Wemco 7613282 P-31
C-123†		CAPACITOR, fixed: 100,000 μμf +20% −10%; same as C-122.	Sweep amplifier inverter coupling		
C-123††		CAPACITOR, fixed: 100,000 μμf +20% −10%; same as C-122††.	Sweep amplifier inverter coupling		
C-124*†	#R16-C-11352-6 3300-319 001 153 #— 3DA500-580	CAPACITOR, fixed: paper-dielectric; 500,000 μμf +20% −10%; 400 vdcw; hermetically sealed non-magnetic metal case; 2″ lg x 1 5/16″ wd x 49/64″ thk, less term; oil filled; 2 solder lug term 3/4″ h max, 5/8″ c to c; no internal ground connection; two 0.144″ diam mtg holes in bracket 1 15/16″ c to c.	Sweep coupling to r-f osc	AWS type CP63B1AE504MK Can be replaced by JAN type CP63B1EF504V	Spec AWS C75.16 Wemco 7613282 P-32 Hazeltine Elec CO-1199 Spec JAN-C-25
C-124††		CAPACITOR, fixed: paper-dielectric, 500,000 μμf +20% −10%; 600 vdcw; no internal ground connection.	Sweep coupling to r-f osc	JAN type CP63B1EF504V	Spec JAN-C-25 Hazeltine Elec CP63B1EF504V
C-125*†		CAPACITOR, fixed: 500,000 μμf +20% −10%; same as C-124*†.	Sweep coupling to r-f osc		
C-125††		CAPACITOR, fixed: 500,000 μμf +20% −10%; same as C-124††.	Sweep coupling to r-f osc		

CONTRACT: *NXsa-59108. †N383s-1427. ††N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number, USAF Stock Number, Navy Type Number, SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
C-126	#R16-C-10017-50 3300-376 037 000 #— 3K2051112	CAPACITOR, fixed: mica 510 μμf ±5%; 500 vdcw.	Sweep coupling to blanking tube	JAN type CM20A511J	Spec JAN-C-5 Wemco 7613282 P-34 Hazeltine Elec CM20A511J
C-127*†		CAPACITOR, fixed: 2 μf +20% −10%; same as C-116*†.	Intensifier pl filter		
C-127††		CAPACITOR, fixed: 2 μf +20% −10%; same as C-116††.	Intensifier pl filter		
C-128	#R16-C-11326-40 3300-316 775 133 #— 3DA100-312	CAPACITOR, fixed: paper-dielectric; 100,000 μμf ±10%; 2500 vdcw; hermetically sealed metal case; 2⅜″ h x 1¼″ wd x ¾″ thk, less mtg bracket; oil filled; no internal ground connections; 2 solder lug term on bottom; two 5/32″ wd mtg slots on bracket 2″ c to c; applicable parts of AWS spec C75.16 or Spec JAN-C-25-4.	CRT intensifier grid coupling	Aerovox #2516CB	Wemco 7613282 P-36 Hazeltine Elec CO-1197
C-129		CAPACITOR, fixed: 10,000 μμf ±10%; same as C-108.	Intensifier grid coupling		
C-130	#R16-C-11338-53 3300-316 563 057 #— 3DA250-166	CAPACITOR, fixed: paper-dielectric; 250,000 μμf +20% −10%; 2000 vdcw; hermetically sealed metal case 2½″ lg x 2½″ wd x 1 3/16″ thk, less term; oil filled; 2 solder lug term 1 5/16″ h max, 1⅛″ c to c; no internal ground connection; clamp mtd; applicable parts of Spec JAN-C-25-4.	CRT cathode bias filter	AWS type CP70E1AJ254MK Aerovox #2009	Spec AWS C75.16 Wemco 7613282 P-38 Hazeltine Elec CO-1198
C-131		Not used.			
C-132		CAPACITOR, fixed: 10,000 μμf ±10%; same as C-108.	Power transf primary bypass		
C-133		CAPACITOR, fixed: 10,000 μμf ±10%; same as C-108.	Power transf primary bypass		
C-134	#R16-C-11437-80 3300-316 958 805 #— 3DB1-183	CAPACITOR, fixed: paper-dielectric 1μf +20% −10%; 1500 vdcw; hermetically sealed metal case; 4¾″ lg x 1 13/16″ wd x 1 1/16″ thk, less term; oil filled; 2 solder lug term 1 5/16″ h max, 13/16″ c to c; no internal ground connections; clamp mtd; applicable parts of Spec JAN-C-25-4.	Neg supply filter	AWS type CP71D1EH105MK Aerovox per Haz CO-1170	Spec AWS C75.16 Wemco 7613282 P-43 Hazeltine Elec CO-1170
C-135		CAPACITOR, fixed: 1 μf +20% −10%; same as C-134.	Neg supply filter and sync coupling		Spec JAN-C-25
C-136		Not used.			

C-137	#R16-C-11679-50 3300-317 371 282 -483345 3DB8-171	CAPACITOR, fixed: paper-dielectric; 3 sect; 8 μf +20% −10% ea sect; 600 vdcw; hermetically sealed steel case, electro tinned; 4¾″ h x 3¾″ lg x 2¼″ wd, less term and bracket; oil filled; 4 ceramic pillar term w/ #10-32 thd studs, 4 nuts, washers, and term lugs supplied; no int gnd connections; bracket supplied for mtg, six 0.173″ diam mtg holes; one common term for all 3 sect.	Consists of C-137A, C-137B, C-137C	Solar 7415448 PT-1 Solar or Aerovox per Haz A-4041	Wemco 7613282 P-46 Hazeltine Elec A-4041 Navy dwg. RE 13A 488
C-137A		CAPACITOR, fixed: 8 μf +20% −10%; part of C-137.	Pos supply filter		
C-137B		CAPACITOR, fixed: 8 μf +20% −10%; part of C-137.	Pos supply filter		
C-137C		CAPACITOR, fixed: 8 μf +20% −10%; part of C-137.	400 v supply filter		
C-138		Not used.			
C-139		CAPACITOR, fixed: 10,000 μμf ±10%; same as C-108.	Regulated output filter		
C-140*†	#R16-C-11310-950 3300-316 777 135 # — 3DA100-483	CAPACITOR, fixed: paper-dielectric; 100,000 μμf +20% −10%; 600 vdcw; hermetically sealed non-magnetic metal case; 1 13/16″ lg x 1″ wd x ¾″ h, less term; oil filled; 2 solder lug term ¾″ h max, 1″ c to c; no internal ground connections; 2 mtg tabs w/3/16″ diam hole in ea on 2⅛″ centers.	Regulated output filter	AWS type CP51B1AF104MK Can be replaced by JAN type CP54B1EF104V	Spec AWS C75.16 Wemco 7613282 P-51 Hazeltine Elec CO-1196 Spec JAN-C-25
C-140††		CAPACITOR, fixed: paper-dielectric; 100,000 μμf +20% −10%; 600 vdcw; no internal ground connections.	Regulated output filter	JAN type CP54B1EF104V	Spec JAN-C-25 Hazeltine Elec CP54B1EF104V
C-141		CAPACITOR, fixed: 1000 μμf ±10%; same as C-101.	I-f filament bypass		
C-142		CAPACITOR, fixed: 100 μμf ±5%; same as C-105.	D-camplifier pl bypass		
CR-101	#R16-T-51723-05 #3300-234 137 300 #1N23A #2J1N23A	CRYSTAL UNIT, rectifying: silicon crystal, ceramic insulation, metal parts silver pl or gold pl; electrical data classified higher than "restricted" cylindrical, w/tip 0.083″ diam x 0.190″ lg max; 0.820″ lg x 0.294″ OD o/a; mtd in crystal holder; base is positive when current flows in the forward (pass) direction.	Rect mixer	JAN type 1N23A	Spec JAN-1A Wemco 7613282 P-56 Hazeltine Elec XL-1003
E-101*	— — -62268 —	R.F. ASSEMBLY: Includes frequency meter, dial, wave guide and attenuators.	R-f mixer and freq indicator	Maguire Ind 1561 and 3005	Wemco 7613282 P-57
E-101§	R16-WX-7613282-P57 3300-326 241 755 -62268-A 3F2789-10	WAVEMETER: meter indicator; 8470-9630 mc freq range; brass, silver pl, plexiglass wavemeter window; 12 7/32″ lg x 6⅛″ diam x 6 1/16″ d incl knob; o/a; incl 1 fixed and 2 variable attenuators, crystal holder assembly, wave guide, klystron tube socket holder, calibrated wavemeter dial and knob, and coupling connector one end; mts by two #8-32 thd stud bolts and screwdriver slot mts; coupling connector one end w/four #8-32 tapped holes on 1.281″ x 1.218″ mtg/c; similar to -62268 except has adjustable mtg facilities; (incl E-108, E-108A, E-108B, E-108C, E-108D, E-108E, E-108F, E-108G, H-116, H-117, H-118, H-119, H-120, H-121, H-125, O-102, O-103, O-105, O-111, O-112, O-113, O-118, X-115).	Freq indicator	Suffolk Prod per Haz A-4179	Hazeltine Elec A-4179

CONTRACT: *NXsa-59108. †N383s-1427. ††N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMPLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
E-101A		FREQUENCY METER: part of E-101; (for reference only).	Freq indicator		
E-101B*†		ATTENUATOR, variable: two micarta strips 4 3/4" x .375" x .031", w/ a brass nickel-pl thd bushing at center of ea strip; one right hand thd, one left hand thd per set. (*Used in serial nos. 1-817 and 1001-1050*).	R-f attenuator	Maguire Ind A2852 and A2849	Wemco 7613282 P-59
E-101B†	*LH thd bushing* # 3300-286 061 515 — 2Z393.2 *RH thd bushing* # 3300-286 061 516 — 2Z393.3	ATTENUATOR, variable: constriction wave guide attenuator; carbon-coated XXT bakelite; 100 ohms per sq ±10%; two flat strips, bowed after screw adj; 4 3/4" lg x 3/8" wd x 0.028" thk; two silver and palladium pl bushings; one 1/4"-28 thd bushing at center of ea strip; one right hand thd, one left hand thd per set; (part of E-101§). (*Used in serial nos 1051-1688.*)	R-f attenuator	Hazeltine Elec A-4166-1 (LH) A-4166-2 (RH)	Hazeltine Elec A-4166-1 (LH) A-4166-2 (RH)
E-101B††	*LH thd bushing* *RH thd bushing*	ATTENUATOR, variable: constriction wave guide attenuator; carbon-coated resin impregnated fiberglass; 100 ohms per sq ±15% two flat strips, bowed after screw adj; 4 3/4" lg x 3/8" wd x 0.025" thk; two silver and palladium pl bushings; w/two spacers; one 1/4"-28 thd bushing at center of ea strip; one right hand thd, one left hand thd per set; (part of E-101§). (*Used in serial nos above 10,000*).	R-f attenuator	Hazeltine Elec A-4166-1 (LH) A-4166-2 (RH)	Hazeltine Elec A-4166-1 (LH) A-4166-2 (RH)
E-101C	#R16-WX-7415393-G1 3300-286 071 250 — 2Z395.48	ATTENUATOR, fixed: composition type; resistance card, 500 ohms per square; 1 w per sq; card dimen 3.312" lg x 0.706" wd x 0.031" thk; uninsulated; card riveted to "T"-shaped bracket, brass, silver and palladium pl; 3 7/8" lg x 5/16" h x 21/32" wd; six 0.093" diam mtg holes; for 9000 mc wave guide.	R-f attenuator	Maguire Ind A2838 Suffolk Prod per Haz A-4167	Wemco 7613282 P-60 Hazeltine Elec A-4167
E-101D	R16-WX-7817813-P1 3300-287 641 454 — 2Z3262-15	ATTENUATOR, filter: r-f choke; round poly-iron non-conductive core; 0.375" lg x 0.235" diam; w/shoulder 0.125" lg x 0.295" diam.	Crystal r-f filter	Maguire Ind A2864 Suffolk Prod per Haz SM-2313	Wemco 7613282 P-61 Hazeltine Elec SM-2313
E-101E	R16-WX-7817733-P1 3300-287 641 456 — 2Z3262-17	ATTENUATOR, filter: r-f choke; round poly-iron non-conductive core; 0.281" lg x 0.293" diam w/shoulder 0.156" lg x 0.343" diam and 0.159" diam hole through center.	R-f osc coupling	Maguire Ind A2865 Suffolk Prod per Haz MP-1249	Wemco 7613282 P-62 Hazeltine Elec MP-1249

E-102	#R16-WX-7416265-G1 3300-296 695 202 # 2Z9439-1	BOARD, terminal: component mtg; 43 nickel silver term lugs, electro tin pl; nylon laminate; 9″ lg x 2¼″ wd x 3/32″ thk; 2 mtg brackets 8½″ c to c; provides mtg for resistors and capacitors, 1 term mtd on opposite side.	Capacitor and resistor mtg	Wemco 7416265 G-1 Hazeltine Elec A-3972	Wemco 7614131 P-1 Hazeltine Elec A-3972
E-103	#R16-WX-7416324-G1 3300-299 510 116 # 2Z9440-116	BOARD, terminal: component mtg; 40 nickel silver term lugs, electro tin pl; nylon laminate; 7 7/16″ lg x 2¼″ wd x 3/32″ thk; 2 mtg brackets 8″ c to c; provides mtg for resistors and capacitors.	Capacitor and resistor mtg	Wemco 7416324 G-1 Hazeltine Elec A-3971	Wemco 7614131 P-2 Hazeltine Elec A-3971
E-104	#R16-WX-7416269-G1 3300-299 494 634 # 2Z9418.54	BOARD, terminal: component mtg; 18 nickel silver term lugs, electro tin pl; nylon laminate; 4 15/16″ lg x 2¼″ wd x 3/32″ thk; 2 mtg brackets 4 15/32″ c to c; provides mtg for resistors.	Resistor mtg	Wemco 7416269 G-1 Hazeltine Elec A-3970	Wemco 7614131 P-3 Hazeltine Elec A-3970
E-105*	R16-WX-74163-00-G1 — — —	BOARD, terminal: varnish impregnated micarta board; 2 7/8″ x x 2¼″ x 3/32″; mounting 9 terminals; used on Serial Nos. 1 to 174 and on 176, 177, 179, 180, 181, 182, 185, 187, 192, 193, 195, 196, 197, 203, 208, 213, 218, 232, 238, 242, 262, 339.	Resistor mtg	Wemco 7416300 G-1	Wemco 7614131 P-4
E-105§		Not used.			
E-106	#R16-WX-7713440-G2 3300-296 657 421 # 2Z9406.214	BOARD, terminal: component, mtg; six #4-40 thd term studs, brass, silver pl; nylon laminate; 2¾″ lg x 1¾″ wd x 15/16″ h overall; four 0.147″ diam mtg holes on 2 9/32″ x ¾″ mtg/c; incl 3 resistors, symbols R-123, R-124, R-125, twelve hex nuts, ceramic insulators, flat washers, and lockwashers; (incl E-124).	Resistor mtg	Wemco 7713440 G-2 Hazeltine Elec A-4018	Wemco 7614131 P-5 Hazeltine Elec A-4018
E-107	R16-WX-7713337-G1 3300-295 578 702 — 2Z8304.84	SHIELD, tube: CRS, copper flash, cad pl; tubular-cone shape for C-R tube; tube clamp held by two #10-32 thd thumbscrews one end, six 0.173″ diam mtg holes on flange other end; 2½″ ID at one end, 3½″ ID other end; support bracket 1⅛″ wd w two 0.173″ diam mtg holes, holds shield 1″ h above chassis, inscribed "DANGER HIGH VOLTAGE"; (incl O-101).	CRT shield	Wemco 7713337 G-1 Suffolk Prod per Haz A-3989	Wemco 7614131 P-6 Hazeltine Elec A-3989
E-108	R16-K-2903-800-10 3300-295 578 702 — 2Z8304.84	HOLDER, crystal: consists of filter attenuator E-101D, body E-108A, cap E-108B, contact E-108C, washer E-108D, insulator bushing E-108E, connector E-108F and retainer ring E-108G; (part of E-101).	Crystal holder	Wemco 7818639 G-1 Suffolk Prod per Haz MD-1410	Wemco 7614131 P-7 Hazeltine Elec MD-1410
E-108A	R16-B-14902-250 3300-286 684 191 — 2Z1612.30	BODY: holds xtal plug cap; brass, free machining; round, p/o xtal holder assem; ⅜″ lg, 0.380″ ID x 9/16″ OD; ½″-32 int mtg thd; ⅛″ wide fine diamond knurl for adjustment; silver and palladium pl; (part of E-108).	Crystal holder plug body	Wemco 7816603 P-1 Suffolk Prod per Haz SM-2305	 Hazeltine Elec SM-2305

CONTRACT: *NXsa-59108. †N383s-1427. ††N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
E-108B	R16-P-3769-600 3300-295 533 325 — 2Z7780-70	CAP: plug type; brass, free machining; p/o xtal holder assem; 0.844″ lg x 0.265″ diam; 3/8″-32 ext mtg thd one end; fine diamond knurl with 1/32″ wd slot for screwdriver adjustment; silver and palladium plated after assem; (part of E-108).	Crystal holder plug cap	Wemco 7816606 P-1 Suffolk Prod per Haz SM-2307	 Hazeltine Elec SM-2307
E-108C	R16-T-1396 3300-287 390 371 — 2Z3193-65	CONTACT, electrical: xtal cont one end, single round male cont other end; p/o xtal holder assem; brass, silver and palladium pl; straight; 1 19/64″ lg x 7/16″ diam overall; mts in connector shell; (part of E-108).	Crystal holder plug contact	Wemco 7816709 P-1 Suffolk Prod per Haz PM-1675	 Hazeltine Elec PM-1675
E-108D	R16-W-853-580 3300-657 798 520 — 6L50523-30	WASHER, flat: electrical mica; round 0.161″ ID, 7/16″ OD, 0.015″ thk; (part of E-108).	Crystal holder plug washer	Wemco 7816588 P-1 Suffolk Prod per Haz IM-1043	 Hazeltine Elec IM-1043
E-108E	R16-W-853-555 3300-331 026 013 — 3G100-13	INSULATOR, bushing: circular; nylon laminate; 7/16″ diam x 0.118″ thk overall, undercut to 0.374″ diam, 0.125″ diam hole through center; (part of E-108).	Crystal holder insul bushing	Wemco 7816604 P-1 Suffolk Prod per Haz BP-1232	 Hazeltine Elec BP-1232
E-108F	R16-B-14902-255 3300-295 560 990 — 2Z8276-44	SHELL, connector: brass, free machining; p/o xtal holder assem; 49/64″ lg x 5/8″ OD; 1/2″-32 ext thd coupling mating end, 3/8″-32 ext thd cable end; thumb knurled surface for adjustment; silver and palladium plated after assem; (part of E-108).	Crystal holder connector shell	Wemco 7414341 P-1 Suffolk Prod per Haz SM-2308	 Hazeltine Elec SM-2308
E-108G	— # — — # —	RING, retainer: snap type; music wire, silver pl; circular; 0.022″ diam wire, 0.100″ ID w/ 1/32″ wd opening; (part of E-108).	Crystal holder retaining ring	Suffolk Prod per Haz FP-1148	Hazeltine Elec FP-1148
E-109	# — 3300-296 641 173 # — 2Z9403.194	BOARD, terminal: general purpose; 3 nickel silver term lugs, electro tin pl; nylon laminate; 2″ lg x 3/4″ wd x 3/32″ thk; two 0.173″ diam mtg holes 1 5/8″ c to c.	Term mtg	Wemco 7410891 G-1 Hazeltine Elec A-3960	Wemco 7614131 P-21 Hazeltine Elec A-3960
E-110		Not used.			
E-111		Not used.			

E-112		Not used.			
E-113		Not used.			
E-114	#R16-WX-7415333-P1 3300-286 382 682 #— 2Z1239.97	BOARD SUBASSEMBLY, terminal: straight shape; nylon laminate; 3⅛″ lg x 1¼″ wd x ⅛″ thk overall; two 0.173″ diam mtg holes at center ⅞″ c to c; two 0.375″ diam holes 1⅞″ c to c; potentiometer support.	Mtg for R-163 and R-165	Wemco 7415333 P-1 Suffolk Prod per Haz BP-1215	Wemco 7614131 P-13 Hazeltine Elec BP-1215
E-115	#— #3300-292 112 074 #— #2Z5753.13	KNOB: round w/octagon thumb grips; black molded plastic; for ¼″ diam shaft; accommodates two #8-32 thd set screws; single white arrow line, pointer tip at edge; 1 1/16″ diam x ⅝″ thk; shaft hole ½″ d.	Control	Wemco 7708220 P-2 Molded Insul per Haz MP-1237-10	Wemco 7614131 P-14 Hazeltine Elec MP-1237-10
E-116*		GROMMET: 1″ OD x ½″ ID x ¼″ thk, soft rubber.	Wire protection	Wemco S#282498	Wemco 7614131 P-15
E-116§	#R33-G-1708 6600-313 500 #— 6Z4920-23	GROMMET: soft black rubber; fits ⅝″ diam hole; ⅜″ diam center hole, ⅞″ diam x 5/16″ wd, 1/16″ wd groove.	Wire protection	Atlan India Rub #2281	Hazeltine Elec MP-1262
E-117	#R16-I-8890 3300-332 591 255 #— 3G1350-126	INSULATOR, stand-off: cylindrical post; grade L-3 ceramic, cylindrical surface glazed; ½″ lg; ⅜″ diam, at ea end one stainless steel mtg insert w/ #6-32 int thd 5/32″ d, insert to withstand 100 lbs tension.	Wire protection insul	JAN type NS3W0104 Wemco 7818639 G-2 Natl Ceramic per Haz INPS62-16	Spec JAN-I-8 Navy dwg. RE-61A-215 Wemco 7614131 P-16 Hazeltine Elec INPS62-16
E-118*		GROMMET: ½″ OD x ⅛″ ID x 5/16″ thk, soft rubber.	Wire protection	Wemco S#660828	Wemco 7614131 P-17
E-118§	#R33-G1702 #6600-309000 #— #6Z4895	GROMMET: soft black rubber; fits 5/16″ diam hole; 3/16″ hole diam x 1/16″ wd groove; 3/16″ wd x 7/16″ diam overall.	Wire protection	Atlan India Rub #2286	Hazeltine Elec MP-1264
E-119	#R33-G-1906-293 #6600-308102 #— #6Z4856-8	GROMMET: soft black rubber; fits ½″ diam hole; ⅜″ hole diam x 1/16″ wd groove; ¼″ wd x 1 1/16″ diam overall.	Wire protection	Pierce Rob #100	Wemco 7614131 P-18 Hazeltine Elec MP-1263
E-120	#R16-K-3374-10 #3300-292 241 249 #— #2Z5822-88	KNOB: round w/octagon thumb grips; black molded plastic; for ¼″ diam shaft; accommodates two #10-32 thd set screws; 1 5/8″ wd across thumb grips, ¾″ thk; shaft hole ½″ d; inside undercut modified to 1⅛″ diam from Kurz-Kash #S-309-64.	Wavemeter control	Maguire Ind 7415149 P-1 Kurz-Kash #S-309-64	Wemco 7614131 P-19 Hazeltine Elec MP-1250

CONTRACT: *NXsa-59108. N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
E-121	R16-K-3443-500 3300-292 181 499 — 2Z5786.106	KNOB: round w/octagon thumb grips; black molded plastic; for 1/4" diam shaft; accommodates one #8-32 thd set screw; 1 1/2" diam x 7/8" thk; shaft hole 1/2" d; single bar pointer tip 7/16" lg inserted through knob shank, 0.218" counterbore.	Control	Wemco 7415805 P-1 Hazeltine Elec A-3976	Wemco 7614131 P-20 Hazeltine Elec A-3976
E-122	#R16-I-8895 3300-332 020 289 #-61662 3G1250-12.16	INSULATOR, stand-off: cylindrical post; grade L-3 ceramic, cylindrical surface glazed; 3/4" lg overall; 3/8" diam, one stainless steel mtg insert w/ #6-32 int thd 1/4" d at ea end.	Stand-off insul	JAN type NS3W0106 Isolantite Natl Ceramic per Haz INPS62-24	Spec JAN-I-8 Navy dwg. RE-61A-215 Wemco 7614131 P-22 Hazeltine Elec INPS62-24
E-123*		Not used.			
E-123§	R16-HZL-FP1132 3300-295 578 955 — 2Z8304 132	SHIELD, tube: aluminum, caustic dipped; rectangular; 63 ventilating holes through top; mounts by two open slots at base on 1 9/16" mtg/c; ID 2 31/32" lg, x 1 31/32" wd x 3 7/32" h; two openings 5/8" wd adjacent at one corner for adj, one opening 5/16" rad for wire leads; 0.020" thk stock.	Shield for V-115	Hazeltine Elec FP-1132	Hazeltine Elec FP-1132
E-124		INSULATOR, bushing: ceramic, round; round shank item code #77; MBCA ref dwg group 9; 0.312" OD, 0.072" h o/a; shank 0.234" OD, 0.010" h; one 0.144" diam through mounting hole on center; general purpose terminal insulator on resistor board; (p/o E-106).	Term ins on board terminal E-106	Hazeltine Elec IN-1053-2	Hazeltine Elec IN-1053-2
E-201	R16-AN-AT-68/UP 1600-327 305 619 AT-68/UP 3F3988-68	HORN, antenna: used with Spectrum Analyzer TS-148/UP; incl pick-up coupling connector w/ female cont; rect alloy metal horn 3/64" thk sheet, flat black finish inside and outside; freq 8500-9600 mc; 3 21/64" lg x 2 13/64" h x 1 3/64" wd overall; horn may be placed in vert or horiz position, 5/8"-24 ext thd on pick-up mtg coupling; AT-68/UP inscribed on side of horn; pick-up coupling for connection to N type cable connector.	Antenna pick-up	Sperry Gyro #5660159 Airtron 19640	Wemco 7613392 P-1 Hazeltine Elec HN-1000
E-202	R16-WX-7415323-G1 3300-298 296 820 UG-183/U 2Z308-183	CONNECTOR, adapter: non-flexible, connection for coaxial adapter assem; rectangular tubular section w/plate cap one end, coupling connector other end, one pin cont connector on side w/ 5/8"-24 ext thd shell; brass body, beryllium copper pin cont; freq range 8500-9600 mc; 2 1/2" lg x 1 5/8" sq overall; coupling connector w/four #8-32 tapped mtg holes on 1.280" x 1.218" mtg/c, incl four #8-32 captive screws.	Coax. to wave guide	Wemco 7415323 G-1 Ind Prod per Haz A-3953 AN type UG-183/U	Wemco 7613392 P-2 Hazeltine Elec A-3953

E-203*	R16-WX-7415324-G1 — — —	WAVE GUIDE ASSEMBLY: CG-182/APM-40-15″: flexible type; same as CG-182/APM-40-18″, except for length.	Antenna pick-up	Titeflex, Inc 7415324 G-1	Wemco 7613392 P-3
E-203§	#R16-AN-CG-182/APM-40 1600-299 540 032 #CG-182/APM-40-18″ 2Z10006-182	WAVE GUIDE: flexible type; rectangular tubular section consists of close wound brass wire, black synthetic rubber molded covering per JAN-W-287, terminated by one brass coupling connector ea end; 18″ lg, conduit 1 1/8″ wd x 21/32″ thk x 15 7/8″ lg, coupling connectors 1 41/64″ sq; ea coupling connector w/four #8-32 tapped mtg holes on 1.281″ x 1.218″ mtg/c, incl four #8-32 thd captive screws; inscribed 40104 WAVEFLEX CG-182/APM-40-18″.	Connects antenna to transmitter unit	Titeflex, Inc. Dwg. #B-40104	Hazeltine Elec CG-1006
E-204	#R16-AN-UG-144/AP 3300-287 675 045 #UG-144/AP 2Z3288-144	ADAPTER, wave guide: brass, silver pl; 1 5/8″ sq x 0.062″ thk; four 0.180″ diam mtg holes on 1.218″ x 1.281″ mtg/c; inscribed UG-144/AP; center opening 0.906″ lg x 0.406″ wd.	Choke-to-choke adapter	Wemco 7818615 P-1 MacKenzie Prod or Wilmar Prod per Haz MS-3314	Wemco 7613392 P-4 Hazeltine Elec MS-3314
F-101A	#R16-F-16305 #8800-361 210 (08B) #-28032-2 #3Z1927	FUSE, cartridge: 2 amp; 250 v, rated continuous at 110% load, open in one hour at 135% load, in 2 min at 200%; one time; glass body; ferrule term; 1 1/4″ lg x 1/4″ diam overall; term 1/4″ diam x 1/4″ d.	Power input	Tobe Benny 1042 Buss 3AG2 Littelfuse 1042	Wemco 7613282 P-63 Hazeltine Elec FU3-2
F-101B	#R17-P-7276 3300-388 280 207 #— 3Z3285-6.6	HOLDER, fuse: cylindrical post w/bayonet type plug; for single fuse of type 3AG or 1/4″ x 1 1/4″ overall dimen types SFE20, ACM, MDL, MTH; molded black phenolic body and plug; 15 amp normal current capacity, used w/25 v and 250 v fuses; 2 7/16″ lg x 11/16″ diam; test probe hold in plug, must not contain materials which are nutrients for fungi; 1/2″-24 thd bushing for single hole mtg, flat for keying, furnished with hardware; 2 solder lug term, one on end, one on side.	Holder for F-101A	 Buss HKM or HKP-HJWR	Wemco 7613282 P-64 Hazeltine Elec FU-10010-2
F-102A		FUSE, cartridge; same as F-101A.	Mounted spare		
F-102B		HOLDER, fuse: same as F-101B.	Holder for F-102A		
H-101	#— #3300-657 647 707 #— #6L17100-16.1	SCREW, thumb: medium straight knurled head with screwdriver slot; stainless steel type 303, passivate finish; #10-32 thd; 1 1/64″ lg overall, 1/2″ diam; 5/16″ full thd; cone point; 1/16″ thk head, 1/2″ diam head; (part of E-107).	Secures CRT shield brkt	Wemco 7813730 P-1 Suffolk Prod or Millen per Haz SC-854	Wemco 7614131 P-28 Hazeltine Elec SC-854
H-102		Not used.			
H-103	#R16-L-5340 3300-286 410 426 #— 2Z1409-53	NUT, lock: shaft locking; 3/8″-32 thd hex head nut, one end unthreaded for 1/4″ diam shaft; brass, nickel pl; incl 3/8″-32 ext thd bushing w/split shank one end, 3/8″-32 int thd other end; hex head nut 1/4″ thk x 7/16″ wd across flats, hex head bushing 1/2″ lg x 1/2″ wd across flats; (furnished as part of R-140, R-144, R-174, R-182, and R-197).	Var resistor lock	 Millen #10061	Wemco 7614131 P-30 Hazeltine Elec NT-10032

CONTRACT: *NXsa-59108. N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
H-104		Not used.			
H-105		Not used.			
H-106	# #6700-665040 # #	SCREW, machine: slot drive; Bind H; brass, bright nickel finish; #2-56 NC-2; 1/8" lg ±1/64"; head 0.181" diam +0.000" −0.010", 0.046" thk +0.000" −0.005"; resistant to salt spray.	Secures identification and name plates	Wemco 7415822 P-226 Guarantee Spec or State Bolt and Screw Co per Haz SB26-BN-4	Wemco 7614131 P-33 Hazeltine Elec SB26-BN-4
H-107	# #6700-665050 # #6L6256-3.16	SCREW, machine: slot drive; Bind H; brass, bright nickel finish; #2-56 NC-2; 3/16" lg ±1/64"; head 0.181" diam +0.000" −0.010", 0.046" thk +0.000" −0.005"; resistant to salt spray.	Front panel screws	Wemco 7415822 P-246 Guarantee Spec or State Bolt and Screw Co per Haz SB26-BB-4	Wemco 7614131 P-42 Hazeltine Elec SB26-BB-4
H-108	R16-WX-7416520-G1 3300-679 481 630 6R38461	WRENCH, tuning: for i-f coils; brass bar, black nickel finish; "L"-shape, 3 9/16" lg x 1/2" wd overall, 1/8" diam; clip mtd to chassis; 0.055" wd x 3/32" d slot one end, incl circular guide sleeve.	Tool	Wemco 7416520 G-1 Suffolk Prod or Lo-Man Mfg per Haz A-3967	Wemco 7614131 P-35 Hazeltine Elec A-3967
H-109	#R16-WX-7611916-P735 #3300-657 685 940 # #6L3946-36	PIN, locking: holds dust cover; stainless steel #303, passivate finish; round; 2 1/4" lg x 0.375" diam overall; 10-32 mtg thd 7/16" lg one end; shaft 0.188" diam, 0.375" diam head w/ 0.129" diam hole through center, head tapered to point other end; (p/o A-102).	Holds dust cover to carriage	Wemco 7814217 P-1 Suffolk Prod or National Co per Haz SM-2195	Wemco 7614131 P-36 Hazeltine Elec SM-2195
H-110	#41-W-2444 #7900-859460 # #6R55499	WRENCH: hexagonal key, double end; 0.050" max across flats; 1 51/64" lg x 35/64" wd x 0.050" wd overall; hardened steel; arms at 90 deg; fits #4 Allen socket-head set screw.	Tool	Allen #050	Wemco 7614131 P-37 Hazeltine Elec WR-10000-1
H-111	#41-W-2445 #7900-859480 # #6R57400-6	WRENCH: hexagonal key, double end; 1/16" max across flats; 1 13/16" lg x 9/16" wd x 1/16" thk overall; hardened steel; arms at 90 deg; fits #5 and #6 Allen socket-head set screw.	Tool	Allen #116	Wemco 7614131 P-38 Hazeltine Elec WR-10000-2

H-112	#41-W-2446 #7900-859490 #— #6R57400	WRENCH: hexagonal key, double end; 5/64″ max across flats; 161/64″ lg x 111/16″ wd x 5/64″ thk overall; hardened steel; arms at 90 deg; fits #8 Allen socket-head set screw.	Tool	Allen #564	Wemco 7614131 P-39 Hazeltine Elec WR-10000-3
H-113	#— 3300-287 171 139 #— 2Z2635.169	CLAMP: tube; mat-nylon laminate; one bolt employed; 3/4″ lg x 3/8″ wd x 3/16″ thk; L-shape, center slot 3/8″ x 1/8″ wd.	Clamp for V-115	Wemco 7820155 P-1 Suffolk Prod per Haz BP-1213	Wemco 7614131 P-40 Hazeltine Elec BP-1213
H-114	#— 3300-287 171 141 #— 2Z2635.171	CLAMP: tube; aluminum, caustic dipped; two 5/32″ diam mtg holes for #6 screws; 115/32″ diam x 1″ h, two mtg tabs w/5/32″ diam holes 115/32″ c to c; designed to hold tube base 13/16″ diam; two parts, base w/8 male thds per inch, top w/8 female thds per inch.	Clamp for V-104	Philco 258-4865, 258-4866 Plume & Atwood 258-4865, 258-4866	Wemco 7614131 P-41 Hazeltine Elec CP-1077
H-115	# # # #	WRENCH: hexagonal key, double end; 3/32″ max width across flats; 23/32″ lg x 3/4″ wd x 3/32″ thk overall; hardened steel; arms at 90 deg; fits #10 Allen socket-head set screw.	Tool for set screws on tuning dial	Allen #332	Hazeltine Elec WR-10000-4
H-116§		STUD: SS, passivate finish; 29/32″ lg o/a; one end threaded 0.468″ lg w/1/4″-28 NF-2 thd, undercut to root diam on 1/16″ lg, other end threaded w/ #8-32 NC-2 thd on 5/16″ lg; 3/4″ diam x 1/16″ thk shoulder located 0.468″ from 1/4″-28 thd end, 3/64″ x 1/16″ d scdr slot on #8-32 thd end, both ends 1/64″ x 45 deg chamfer; (p/o E-101§).	Mounts wavemeter E-101	Hazeltine Elec SM-2324	Hazeltine Elec SM-2324
H-117§		BOLT, set: steel; copper plated, followed by cadmium plating; special hardness; headless, Allen hexagonal drive; cup point; #6-32 NC 3 fit, 23/64″ min lg; nominal lg 3/8″; (p/o E-101§).	Mounts H-116 and O-118	Hazeltine Elec SSS62C-12	Hazeltine Elec SSS62C-12
H-118§		NUT, plain round: stainless steel; passivate finish; slot type drive; #8-32 class 2 fit; 3/8″ OD; 5/8″ h o/a; (p/o E-101§).	Mounts wavemeter E-101	Hazeltine Elec SM-2327	Hazeltine Elec SM-2327
H-119		WASHER, flat: round; formica; center hole 0.089″ diam, 82 deg countersink, OD 3/8″, 0.031″ nominal material thickness; #2 nominal screw size; (p/o E-101§).	Guide for E-101B attenuator strips	Hazeltine Elec BP-1235	Hazeltine Elec BP-1235
H-120		WASHER, flat: round; formica; center hole 0.089″ diam, 5/32″ OD; 0.031″ nominal material thickness; #2 screw size; (p/o E-101).	Spacer for H-119	Hazeltine Elec IM-1045	Hazeltine Elec IM-1045
H-121		BOLT, machine: brass; silver plated; flat head; wrench drive at point; #2-56 NC-2 thread; 0.281″ nominal length; flats spaced 3/64″ on 1/16″ length; (p/o E-101).	Mounts H-119	Hazeltine Elec SC-872	Hazeltine Elec SC-872
H-122§		WASHER, flat: round; brass; nickel plated; center hole 0.187″ diam; 3/4″ OD; 0.062″ nominal thickness; #8 nominal bolt size.	For H-116 at choke end of wavemeter	Hazeltine Elec PW-1074	Hazeltine Elec PW-1074

CONTRACT: NXsa-59108. N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
H-123§		WASHER, flat: rectangular; brass; nickel plated; 0.170″ diam; 3/4″ lg x 3/8″ wd x 1/16″ material thickness; 1/16″ nominal material thickness; #8 screw size.	For H-116 at tube end of wavemeter	Hazeltine Elec WA-1119	Hazeltine Elec WA-1119
H-124		BOLT, set: steel; special hardness; cadmium plated; headless; Allen drive, hexagonal; 3/16″ lg; cup point; #6-32 NC class 3 fit; nominal length 3/16″.	Mounts coupling O-119	Hazeltine Elec SSS62C-6	Hazeltine Elec SSS62C-6
H-125		BOLT, set: steel; special hardness; cadmium plated; headless; Allen drive, hexagonal; cup point; #4-40 NC class 3 fit; 7/64″ min length; nominal length 1/8″; (p/o E-101).	Assemble O-102 to O-105	Hazeltine Elec SSS40-C-4	Hazeltine Elec SSS40-C-4
H-126		HANDLE: carrying casehandle; steel, finish dark gray baking enamel; 4 7/8″ lg x 4.125″ h not including grip; four 0.266″ diam mtg holes on 2 lines 2.875″ apart, 2.625″ c to c top line 3.750″ c to c bottom line; folds flat when not in use; (p/o A-101).	Carrying handles for Transit Case CY-246/U	Hazeltine Elec HA-1002	Hazeltine Elec HA-1002
H-127		WASHER, flat: round; lead; center hole 0.265″ diam 17/32″ OD; 0.015″ nom matl thk; 5/16″ screw size; (p/o A-101).	Mounts H-126	Hazeltine Elec PW-1065-2	Hazeltine Elec PW-1065-2
H-128		CATCH, fastener: for latch type cover fastener; steel, dark gray baking enamel finish; hook shaped; 1″ lg x 1 1/16″ h x 9/16″ wd; two 13/64″ dia mtg holes 9/16″ c to c, located 3/16″ from top edge; p/o Corbin, New Britain, Conn; Part #15642SC; (p/o A-101).	Cover fastener of carrying case, mts on cover	Hazeltine Elec LT-1007-1	Hazeltine Elec LT-1007-1
H-129		HASP, fastener: for latch type cover fastener; steel, dark gray baking enamel finish; rectangular in shape "U" shaped hasp; 3″ lg x 1 1/8″ wd x 5/16″ thk; two mtg holes 7/32″ diam on 1 1/8″ mtg/c; p/o Corbin, New Britain, Conn; Part #15642SC; (p/o A-101).	Cover fastener of carrying case mts on case	Hazeltine Elec LT-1007-2	Hazeltine Elec LT-1007-2
H-130		WASHER, flat: round; lead; center hole 0.203″ diam; OD 7/16″; 0.015″ nominal material thickness; (p/o A-101).	Mounting for H-129	Hazeltine Elec PW-1065-1	Hazeltine Elec PW-1065-1
H-131		HANDLE: for chassis and panel assembly; CR steel grip and bkt; 7 3/8″ lg x 5/8″ wd x 1.624″ high; 3/8″ diam CR steel grp, 7 3/8″ overall lg; 2 mtg holes 0.180″ diam on bracket 6 5/8″ c to c; brackets "L" shaped inwardly.	Chassis panel handle	Hazeltine Elec A-3952	Hazeltine Elec A-3952
H-132		WASHER, flat: monel metal, compressed mesh; round, 5/32″ ID, 1/16″ thk; 3/8″ OD; cushion type.	Mounting for E-117	Metal Textile Corp Part #MT-67-4	Hazeltine Elec WA-10078-2
I-101A	#R-17-L-6305 #8800-444200 # #2Z5927	LAMP, incandescent: 6-8 v, 0.25 amp; bulb T-3 1/4 clear, blue bead; 1 3/16″ lg overall; miniature bayonet base; tungsten fil; burn any position.	Dial illumination	GE #44	Wemco 7613282 P-68 Hazeltine Elec BU-1007

I-101B	#R17-H-5985 3300-292 329 777 # — 2Z5883-327	SOCKET, tube: 2 miniature cont; shell, brass, silver pl; steel, cadmium pl mtg bracket; two 3/16″ diam mtg holes 5/16″ c to c; round phenolic insert; phosphor bronze silver pl cont; two key slots in shell for bayonet mtg, incl one solder lug term on side, and one on bottom.	Holder for I-101A	Amer Rad Hdwe #1539	Wemco 7613282 P-69 Hazeltine Elec SO-1053
I-102A		LAMP, incandescent: same as I-101A.	Dial illumination		
I-102B		HOLDER, lamp: same as I-101B.	Holder for I-102A		
J-101	#R16-J-3102 #3300-291 824 000 #-49787 #2Z5531.2	JACK, telephone: for 2 cond 0.251″ diam plug; 1 19/32″ lg x 5/8″ wd x 1 3/64″ h overall; J4 cont arrangement; 3/8″-32 thd mtg bushing 5/16″ lg, furnished with hex nut and lock washer; 3/8″ diam mtg hole; must not contain any materials which are nutrients for fungi; subject to 200 hr salt spray test.	D-c amplifier input	Mallory A-2A	Wemco 7613283 P-73 Hazeltine Elec RC-1138
J-102	#R17-R-2242 8800-017403 #-491115 3H4674A/R4	CONNECTOR, receptacle: 2 male rectangular blade cont; straight; 1 1/2″ diam x 1 1/4″ d, mtg saddle 2 7/16″ lg x 1 23/32″ wd; 105-125 v AC, 125 w, 50-1200 cps; CRS body and mtg saddle; two screw term; two 5/32″ diam holes on mtg saddle 1 5/16″ c to c; molded phenolic insert.	110 v input socket	Bryant Elec type UR	Wemco 7613283 P-74 Hazeltine Elec RC-1127
J-103	# — 3300-287 222 583 # — 2Z2712.40	CAP: tube; black phenolic shell, phosphor bronze, nickel pl cont; 25/32″ h x 19/32″ diam less lead; designed to clip 23/64″ diam tube top.	Clip for V-110	Alden #91S	Wemco 7613283 P-75 Hazeltine Elec TC-1005
J-104	#R15-C-20189-250 3300-287 237 667 # — 2Z2726.56	CAP: tube; black phenolic shell, phosphor bronze, nickel pl cont; 19/32″ h x 7/16″ diam less lead; designed to clip 1/4″ diam tube top; furnished w/ lead 6 7/8″ lg, stripped on 3/8″ lg.	Clip for V-115	Alden #90-L	Wemco 7613283 P-76 Hazeltine Elec TC-1006
L-101	R16-WX-7713258-G1 3300-308 415 912 -472266 3C1084Z25-2	COIL, RF: 1st IF; one winding, single layer wound; shielded, cylindrical bakelite case; 10 3/4 turns #30 AWG wire; 1 1/16″ diam x 1 21/32″ d o/a; iron core; permeability tuned by tuning wrench; 3/8″-32 thd x 1/4″ lg mtg bushing; two solder lug term on side; 1.8 μh to 3.5 μh inductance range; incl hex head nut and lock washer.	1st i-f coil	Wemco 7713258 G-1 Hazeltine Elec A-4010-1	Wemco 7613282 P-83 Hazeltine Elec A-4010-1
L-102	R16-WX-7713258-G2 3300-308 415 913 -472267 3C1084Z25-3	COIL, RF: oscillator converter; one tapped winding, single layer wound; shielded, cylindrical bakelite case; 14 3/4 turns #31 AWG wire tapped at 1 3/4 turns; 1 1/16″ diam x 1 21/32″ d o/a; iron core; permeability tuned by tuning wrench; 3/8″-32 thd x 1/4″ lg mtg bushing; 3 solder lug term on side; 2.7 μh to 5.7 μh inductance range; incl hex head nut and lock washer.	Converter osc	Wemco 7713258 G-2 Hazeltine Elec A-4010-2	Wemco 7613283 P-84 Hazeltine Elec A-4010-2
L-103	R16-C-27556-150 3300-308 415 911 -472274 3C1084Z25-1	COIL, RF: 2nd IF; single winding, Universal wound; cylindrical aluminum shield; 33 1/2 turns double silk or nylon covered enamel Litz wire; 1″ diam x 2 7/8″ h o/a less 13/32″ term; iron core; permeability tuned by tuning wrench; one 1/4″-20 thd mtg stud; two #6-32 thd screw term at one end; 10 μμf ±0.5 μμf across term.	2nd i-f coil	Wemco 7713258 G-2 Hazeltine Elec A-4004	Wemco 7613283 P-85 Hazeltine Elec A-4004

CONTRACT: NXsa-59108. N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
L-104*	— — -302671 —	COIL, AF: fixed, 6.5 hy; 65 ma.	Power supply filter	Wemco L-423178	Wemco 7613283 P-86
L-104§	R16-WX-L423178 3300-308 034 024 -304647 3C575-20	REACTOR: filter; 6.5 hy ea side of CT at 0.065 amp DC measured at 3.0 v, 60 cps; 250 ohms ±15% DC resistance ea sect; HS CRS case, gray enamel finish; 1000 v ins test; 3 5/16″ lg x 2 7/8″ wd x 1 13/16″ h excl term and mtg bkt; one 5/32″ diam hole and one 5/32″ wd x 5/16″ lg slot on 4 9/16″ mtg/c; three slotted term on ceramic bushings 9/16″ h; oil filled; (incl L-106).	Power supply filter	Freed Trans per Haz CL-1119	Hazeltine Elec CL-1119
L-105	# 3300-307 694 900 -472273 3C332-283	COIL, RF: choke; five pie universal wnd coils; HS glass encl envelope, aluminum cap ends; 2.1 mh inductance; 1 3/4″ lg x 11/16″ diam less term; ceramic form, air core; mts by 2 axial wire leads.	I-f choke	Hanovia Chem #HCH-1	Wemco 7613283 P-87 Hazeltine Elec CL-1127
L-106*		COIL, AF: same as L-104*.	Power supply filter		
L-106§		REACTOR: part of L-104§.	Power supply filter		
O-101	# 3300-291 613 129 # 2Z4868.298	GASKET: cushion for C-R tube; adhesive coated sponge rubber; 10 13/32″ lg x 1″ wd x 3/8″ thk; bulk cut strip; (p/o E-107).	CRT gasket	Wemco 771333 P-7 Atlan India Rub per Haz MP-1229	Wemco 7614131 P-47 Hazeltine Elec MP-1229
O-102	R16-WX-7817729-P1 3300-298 394 651 — 2Z8203-104	SHAFT: variable attenuator; nylon laminate; round; 3 7/32″ lg x 0.248″ diam overall; 1/4″-28 mtg thd 25/32″ lg; shaft undercut to 0.138″ diam x 1 5/32″ lg one end; (p/o E-101).	Shaft for E-101B	Maguire Ind A2863 Suffolk Prod per Haz BP-1234	Wemco 7614131 P-48 Hazeltine Elec BP-1234
O-103	R16-WX-7817688-P1 3300-656 437 540 — 6L58754-3	WASHER, flat: stainless steel, passivate finish; round, 0.251″ ID, 0.500″ OD, 0.031″ thk, with 0.109″ wide tab on OD surface, and 0.064″ wd notch on OD surface; stop type; (p/o E-101).	Rotation limiter	Maguire Ind A663 Suffolk Prod per Haz WA-1127	Wemco 7614131 P-49 Hazeltine Elec WA-1127
O-104		Not used.			
O-105	R16-WX-7817730-P1 3300-298 394 652 — 2Z8203-105	SLEEVE, plug: nylon laminate; 1 1/8″ lg, 1/2″ diam head w/two #4-40 tapped holes for #4-40 thd set screws; 1/4″-28 ext full thd shaft 25/32″ lg; 0.140″ diam hole through center; (p/o E-101).	E-101B sleeve	Maguire Ind A2847 Suffolk Prod per Haz BP-1233	Wemco 7614131 P-51 Hazeltine Elec BP-1233

O-106	#R16-WX-7415185-P1 3300-287 726 027 — 2Z3352.114	GLASS: cathode-ray tube filter; green plexiglass; round; 3.125″ diam x 1/8″ thk; free from imperfections and scratches.	CRT filter	Wemco 7415185 P-1 type #260 Steiner type #110 or Crystal Plastics per Haz PX-1022	Wemco 7614131 P-5 Hazeltine Elec PX-1022
O-107	# — #3300-298 394 655 # — #2Z8203-108	SHAFT: tuning; nylon laminate; round; 3 5/32″ lg x 0.248″ diam o/a, w/two flats 1/2″ lg one end, 5/16″ lg other end, ea 1/32″ d, located 120 deg apart at ea end.	Tuning shaft	Wemco 7817811 P-1 S. B. Smith or A. W. Franklin Co. per Haz BP-1221	Wemco 7614131 P-53 Hazeltine Elec BP-1221
O-108	#R16-WX-7611916-P722 3300-287 178 351 # — 2Z2642.125	CLAMP: tube; brass, nickel silver finish; one bolt employed; 2 1/8″ lg x 1 3/8″ wd x 9/16″ h overall, 1 mtg foot w/slot for #6-32 thd screw; designed to hold tube base 1 5/32″ diam; spring clamp ring w/lever.	Tube clamp	Wemco 7611463 G-17 Waterfield per Haz CP-1053-G-17	Wemco 7614131 P-54 Hazeltine Elec CP-1053-G-17
O-109	#R16-WX-7611463-G20 3300-287 178 354 # — 2Z2642.128	CLAMP: tube; brass, nickel silver finish; one bolt employed; 1 31/32″ lg x 9/16″ h x 1 7/16″ wd overall, 1 mtg foot w/slot for #6-32 thd screw; designed to hold tube base 1 23/64″ diam; spring clamp ring w/lever.	Tube clamp	Wemco 7611463 G-20 Waterfield per Haz CP-1053-G-7	Wemco 7614131 P-55 Hazeltine Elec CP-1053-G-7
O-110	#R16-WX-7416392-P1 3300-299 554 585 — 2ZA1352-96	GLASS: dial cover; clear lucite or plexiglass; square; 2 3/8″ h x 1 15/16″ wd x 1/16″ thk overall; four 0.147″ diam mtg holes on 2.000″ x 1.562″ mtg/c; polished both sides, ea side cut out 1 5/8″ lg x 3/8″ wd.	Freq meter window	Wemco 7416392 P-1 Steiner or Crystal Plastics per Haz PX-1021	Wemco 7614131 P-56 Hazeltine Elec PX-1021
O-111	R16-WX-7614131-P57 3300-656 437 539 — 6L58754-2	WASHER, flat: stainless steel, passivate finish; round, 0.296″ ID, 0.500″ OD, 0.031″ thk, with 0.109″ wd tab on OD surface; stop type; (p/o E-101).	Rotation limiter	Maguire Ind A2875-C Suffolk Prod per Haz WA-1128	Wemco 7614131 P-57 Hazeltine Elec WA-1128
O-112	R16-WX-7614131-P58 3300-656 437 537 — 6L58753-2	WASHER, flat: stainless steel, passivate finish; round, 0.205″ ID, 0.500″ OD, 0.031″ thk, with twelve 0.033″ wd x 0.060″ lg serrated teeth on ID surface, and 0.109″ wd tab on OD surface; stop type with pitched internal teeth; (p/o E-101).	Stop washer drive	Maguire Ind A-2587-C Suffolk Prod per Haz WA-1126	Wemco 7614131 P-58 Hazeltine Elec WA-1126
O-113	R16-WX-7614131-P59 3300-656 683 840 — 6L73614-3	WASHER, spring: phosphor bronze, #6 hard; circular, 13/16″ OD, 0.296″ diam ID; 6 slots 1/16″ wd equally spaced 3/8″ lg; edge crimped 3/32″ h, 0.014″ stk; (p/o E-101).	Stop washer tension plate	Maguire Ind A-2585-C Suffolk Prod per Haz SP-1120	Wemco 7614131 P-59 Hazeltine Elec SP-1120

CONTRACT: *NXsa-59108. N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
O-114	#R16-WX-7611916-P736 3300-299 450 204 # — 2Z8879-104	SPRING: tension type; 0.030″ diam music wire, nickel pl; 0.204″ ID, 1″ lg; 9 turns; LH turns; squared ends; (p/o A-102).	Spring for H-109	Wemco 7814216 P-1 Suffolk Prod or National Co per Haz SP-1111	Wemco 7614131 P-60 Hazeltine Elec SP-1111
O-115	#R16-WX-7415678 3300-295 616 516 # — 2Z8496-10	BUMPER: shock absorber type; black rubber insert, Buna type "S", 30-35 durometer hardness, 3″ lg x 1″ wd x 1 3/16″ thk, mounted on steel flange 4 1/4″ lg x 1 1/4″ wd x 0.0598″ thk, two 7/32″ diam mtg holes 3.625″ c to c.	Shock absorber	Wemco 7415678 G-1 Barry Corp per Haz A-4022	Wemco 7614131 P-61 Hazeltine Elec A-4022
O-116	#R16-WX-7416687-G1 3300-295 616 517 # — 2Z8496-11	BUMPER, shock absorber type; black rubber insert, Buna type "S", 30-35 durometer hardness, 5″ lg x 1″ wd x 3/4″ thk, mounted on steel flange 6 1/4″ lg x 1 1/4″ h x 0.0598″ thk, two 13/64″ diam mtg holes 5 5/8″ c to c; (p/o A-101).	Shock absorber	Wemco 7416687 G-1 Barry Corp per Haz A-3964	Wemco 7614131 P-62 Hazeltine Elec A-3964
O-117	#R16-WX-7714401-P1 3300-291 613 128 # — 2Z4868.297	GASKET: carrying case; black Buna "N" or neoprene 25-35 plus durometer hardness; rectangular, 24 11/16″ lg x 12 5/16″ wd x 3/8″ thk overall; one center opening 22 15/16″ lg x 10 9/16″ wd; (p/o A-101).	Moisture seal	Wemco 7714401 P-1 Cont Rub per Haz GA-1064	Wemco 7614131 P-63 Hazeltine Elec GA-1064
O-118		SHAFT: wavemeter attenuator adj; SS, passivate finish; barrel shaped shoulder, round; 2 43/64″ lg not including pin protruding 0.025″, 5/8″ diam o/a, max, 0.247″ diam shaft w/shoulder 0.375″ diam; two #6-32 NC-2 mtg holes, spaced at 90 deg on shoulder and located 25/64″ from end; 0.247″ diam shaft end w/two flats 5/16″ lg at 60 deg; (p/o E-101).	For control wavemeter attenuator	Hazeltine Elec A-4341	Hazeltine Elec A-4341
O-119		COUPLING, rigid: sleeve type; 0.250″ shaft size ea end; 4 set screw mounting; 1 1/2″ lg x 1/2″ diam; brass, nickel pl.	Coupling E-121 and S-103 shafts	Hazeltine Elec SM-2193	Hazeltine Elec SM-2193
O-120		PLATE, spacer: spaces latch from case; aluminum, dark gray baking enamel; rectangular; 1 5/8″ lg x 1″ wd x 1/4″ thk; two 0.213″ diam mtg holes 1 1/8″ c to c, on ctr line of face; (p/o A-101).	Mounts H-129	Hazeltine Elec MS-2985	Hazeltine Elec MS-2985
P-101	R16-P-3627-650 3300-299 835 263 UG-276/U 2Z7390-276	CONNECTOR, receptacle: one round female cont; SKL right angle type; 1/2″ diam 1 3/16″ lg x 7/8″ h; aluminum body, silver pl; polystyrene insert; 1/4″ diam cable opening; 3/8″-32 int thd coupling female cont end, solder term other end (part of W-101).	Crystal cable	AN type UG-276/U Sperry Gyro S-3011 Ind Prod #12425	 Wemco 7613283 P-88 Hazeltine Elec PL-1096

P-201	# — # — # — # —	CONNECTOR, plug: two parallel female cont, straight; 1″ diam x 2 1/16″ lg o/a; 10 amp, 250 v, or 15 amp, 125 v; cylindrical; black rubber body; cord diam 0.325″ to 0.340″ diam; not procurable separately but only molded w/cable DCOP-2, W-201A; (for reference only; p/o W-201).	Plug for cable W-201	Belden #H-1119	Hazeltine Elec PL-1106
P-202	# — # — # — # —	CONNECTOR, plug: 2 parallel grip prongs, straight; 1″ diam 1 1/16″ lg, less prongs; 10 amp, 250 v, or 15 amp, 125 v; cylindrical black rubber body w/finger grip; cable opening 0.325″ to 0.340″ diam (p/o W-201).	Plug for cable W-201	Belden #H-1047	Hazeltine Elec PL-1105
P-203*†	#R16-P-4585 #3300-293 625 500 #-49109 #2Z7155	PLUG, telephone: 2 cond; single shank; black bakelite shell; shank 1/4″ diam x 1 1/4″ lg, tubular shell 1/2″ diam x 1 5/8″ lg, 2 7/8″ lg overall; 2 screw term for cable termination (part of W-202).	Mixer cable plug	 Telephonics PL-55	Wemco 7613392 P-11 Hazeltine Elec PL-1090
P-203††		PLUG, telephone: 2 cond; single shank; black bakelite shell; shank 1/4″ diam x 1 1/4″ lg, tubular shell 1/2″ diam x 1 5/8″ lg, 2.780″ lg overall; 2 screw term for cable termination (p/o W-202††).	Mixer cable plug	Insuline Corp per Haz PL-1090A	Hazeltine Elec PL-1090A
P-204*†		PLUG, telephone: same as P-203*† (part of W-202*†).	Mixer cable plug		
P-204††		PLUG, telephone: same as P-203†† (p/o W-202††).	Mixer cable plug		
P-205*	— 3300-294 732 190 UG-21/U 2Z7390-21	PLUG: Type "N" connector, submersion proof; (p/o W-203*).	Antenna horn cable plug	AN type UG-21/U	Wemco 7613392 P-13
P-205§	#R16-P-5020 3300-294 732 192 #UG-21B/U 2Z7390-21B	CONNECTOR, male contact: plug; 1 round pin cont; straight; 1 3/4″ lg x 13/16″ diam overall; low power rating 500 v, 50 ohms impedance; cylindrical brass silver pl body; GE-1421 insert; cable opening 0.449″ diam; 5/8″-24 thd int coupling mating end, furnished with 5/8″-24 thd gland nut other end; subject to 50 hr salt spray test (part of W-203§).	Antenna horn cable plug	AN type UG-21B/U Ind Prod per Haz PL-1101-2	Navy dwg. RE-49F-402 Hazeltine Elec PL-1101-2
P-206*		CONNECTOR, plug: same as P-205* (part of W-203*).	Antenna horn cable plug		
P-206§		CONNECTOR, plug: same as P-205§ (p/o W-203§).	Antenna horn cable plug		

CONTRACT: *NXsa-59108. †N383s-1427. ††N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
R-101	#R16-R-17344-190 #3300-381 166 220 # — #3R20BF104K	RESISTOR, fixed: composition; 100,000 ohms ±10%; ½ w.	I-f grid bias filter	JAN type RC20BF104K	Spec JAN-R-11 Wemco 7613283 P-89 Hazeltine Elec RC20BF104K
R-102*	R16-R-17310-6115 3300-381 317 120 — 3RC30BF153J	RESISTOR, fixed: composition; 15,000 ohms ±5%; 1 w; 11/16" lg x ¼" diam; phenolic insulation; two wire leads 1½" lg. *Used on all sets up to serial number 25.*	1st i-f screen filter	AWS type RC30BF153J	Spec AWS C75.7 Wemco 7613283 P-90
R-102	#R16-R-17310-12-50 #3300-381 316 140 # — #3RC30BF103J	RESISTOR, fixed: composition; 10,000 ohms ±5%; 1 w. *Used on all sets above serial number 25.*	1st i-f screen filter	JAN type RC30BF103J	Spec JAN-R-11 Wemco 7613283 P-90 Hazeltine Elec RC30BF103J
R-103		RESISTOR, fixed: 10,000 ohms ±5%; same as R-102. *See both descriptions.*	1st i-f screen filter		
R-104	#R16-R-17352-1-30 #3300-381 168 180 # — #3RC20BF224K	RESISTOR, fixed: composition; 220,000 ohms ±10%; ½ w.	Grid leak converter	JAN type RC20BF224K	Spec JAN-R-11 Wemco 7613283-P92 Hazeltine Elec RC20BF224K
R-105	#R16-R-17310-172-50 #3300-381 168 120 # — #3RC20BF223K	RESISTOR, fixed: composition; 22,000 ohms ±10%; ½ w.	Converter osc grid leak	JAN type RC20BF223K	Spec JAN-R-11 Wemco 7613283 P-93 Hazeltine Elec RC20BF223K

R-106	#R16-R-17299-10-500 3300-381 320 840 #— 3RC30BF752J	RESISTOR, fixed: composition; 7500 ohms ±5%; 1 w.	Converter screen filter	JAN type RC30BF752J	Spec JAN-R-11 Wemco 7613283 P-94 Hazeltine Elec RC30BF752J
R-107		RESISTOR, fixed: 7500 ohms ±5%; same as R-106.	Converter screen filter		
R-108	#R16-R-17266-118-500 3300-381 316 420 #— 3RC30BF112J	RESISTOR, fixed: composition; 1100 ohms ±5%; 1 w.	Converter pl supply filter	JAN type RC30BF112J	Spec JAN-R-11 Wemco 7613283 P-96 Hazeltine Elec RC30BF112J
R-109		RESISTOR, fixed: 1100 ohms ±5%; same as R-108.	Converter pl supply filter		
R-110		RESISTOR, fixed: 22,000 ohms ±10%; same as R-105.	Detector pl filter		
R-111	#R16-R-17348-50 #3300-381 167 200 #— #3RC20BF154K	RESISTOR, fixed: composition; 150,000 ohms ±10%; ½ w.	Detector cathode output load	JAN type RC20BF154K	Spec JAN-R-11 Wemco 7613283 P-99 Hazeltine Elec RC20BF154K
R-112	#R16-R-17354-6-100 #3300-381 169 020 #— #3RC20BF334K	RESISTOR, fixed: composition; 330,000 ohms ±10%; ½ w.	Detector pl filter	JAN type RC20BF334K	Spec JAN-R-11 Wemco 7613283 P-100 Hazeltine Elec RC20BF334K
R-113		Not used.			
R-114	#R16-R-17331-74 #3300-381 169 800 #— #3RC20BF473K	RESISTOR, fixed: composition; 47,000 ohms ±10%; ½ w.	Video coupling	JAN type RC20BF473K	Spec JAN-R-11 Wemco 7613283 P-102 Hazeltine Elec RC20BF473K
R-115		Not used.			

CONTRACT: *NXsa-59108. N383s-1427. N383s-45628. N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
R-116		RESISTOR, fixed: 47,000 ohms ±10%; same as R-114.	Neg bias divider		
R-117*	— — -633807-10 —	RESISTOR, variable: 50,000 ohms ±10%, linear taper, 2 w, case 1.227″ diam x 9/16″ thk; 3 terminals; shaft 0.250″ diam x 1/4″ lg from 3/8″ bushing, with screwdriver slot.	Vert centering	Stackpole 7713389 P-9	Wemco 7613283 P-105
R-117§	#R16-P-5587-800 3300-394 386 272 #-636033-L10 3Z7450-31	RESISTOR, variable: composition; 50,000 ohms ±10%; 2 w, 70°C max continuous operation; 3 solder lug term; enclosed metal case 1 1/16″ diam x 9/16″ d; slotted metal shaft 0.250″ diam x 5/8″ lg from mtg surface; linear taper; insulated contact arm, without off position; normal torque, furnished w/1 nut and washer; bushing 3/8″-32 thd x 3/8″ lg, 2 non-turn devices located on 17/32″ rad at 3 and 9 o'clock not used.	Vert centering control	AB type "J" per Hazeltine Elec RM11SB503UK	Hazeltine Elec RM11SB503UK
R-118		RESISTOR, fixed: 47,000 ohms ±10%; same as R-114.	Detector bias divider		
R-119	#R16-R-17374-25 #3300-381 166 280 #— #3RC20BF105K	RESISTOR, fixed: composition; 1 meg ±10%; 1/2 w.	Horiz amplifier grid coupling	JAN type RC20BF105K	Spec JAN-R-11 Wemco 7613283 P-107 Hazeltine Elec RC20BF105K
R-120		Not used.			
R-121	#R16-R-17338-1-103 3300-381 170 200 #— 3RC20BF563J	RESISTOR, fixed: composition; 56,000 ohms ±5%; 1/2 w.	Video pl load	JAN type RC20BF563J	Spec JAN-R-11 Wemco 7613283 P-109 Hazeltine Elec RC20BF563J
R-122		RESISTOR, fixed: 100,000 ohms ±10%; same as R-101.	Video screen divider		
R-123	#R16-R-17326-316 #3300-381 168 960 #— #3RC20BF333K	RESISTOR, fixed: composition; 33,000 ohms ±10%; 1/2 w.	CRT intensifier grid coupling	JAN type RC20BF333K	Spec JAN-R-11 Wemco 7613283 P-111 Hazeltine Elec RC20BF333K

R-124		RESISTOR, fixed: 220,000 ohms ±10%; same as R-104.	CRT intensifier grid isolation		
R-125		RESISTOR, fixed: 100,000 ohms ±10%; same as R-101.	CRT focusing anode isolation		
R-126	#R16-R-17261-19 #3300-381 166 040 #— #3RC20BF101K	RESISTOR, fixed: composition; 100 ohms ±10%; ½ w.	D-c amplifier input coupling	JAN type RC20BF101K	Spec JAN-R-11 Wemco 7613283 P-114 Hazeltine Elec RC20BF101K
R-127	#R16-P-5583-7-675 3300-298 380 146 #-631667-10 2Z7269.99	RESISTOR, variable: composition; 5000 ohms ±10%; 2 w, 70° C max continuous operation; 3 tinned term; enclosed metal case 1 1/16″ diam x 9/16″ d; round metal shaft 0.250″ diam x ¾″ min lg from mtg surface; linear taper; insulated contact arm, without off position; normal torque; mtg bushing ⅜″-32 thd x ⅜″ lg, 2 non-turn devices on 17/32″ rad at 3 and 9 o'clock, not used; must not contain materials which are nutrients for fungi, resistant to salt spray.	D-c amplifier input control	AB 7713389 P-14 AB type "J" per Hazeltine Elec RM11RC502UK	Wemco 7613283 P-115 Hazeltine Elec RM11RC502UK
R 128		RESISTOR, fixed: 1 meg ±10%; same as R-119.	D-c amplifier pl load		
R-129		RESISTOR, fixed: 22,000 ohms ±10%; same as R-105.	D-c amplifier screen divider		
R-130		RESISTOR, fixed: 22,000 ohms ±10%; same as R-105.	D-c amplifier screen divider		
R-131*†	#R16-R-17279-0-925 3300-381 168 900 #— 3RC20BF332K	RESISTOR, fixed: composition; 3300 ohms ±10%; ½ w. *Used in all sets with serial numbers below 1059.*	D-c amplifier screen divider	JAN type RC20BF332K	Spec JAN-R-11 Wemco 7613283 P-119 Hazeltine Elec RC20BF332K
R-131§	#R16-R-17275-85-500 3300-381 168 480 #— 3RC20BF272J	RESISTOR, fixed: composition; 2700 ohms ±5%; ½ w. *Used in all sets with serial numbers above 1060.*	D-c amplifier screen divider	JAN type RC20BF272J	Spec JAN-R-11 Hazeltine Elec RC20BF272J
R-132	#R16 R 17259-41-3 #3300-381 169 960 #— #3RC20BF510J	RESISTOR, fixed: composition; 51 ohms ±5%; ½ w.	D-c amplifier bias	JAN type RC20BF510J	Spec JAN-R-11 Wemco 7613283 P-120 Hazeltine Elec RC20BF510J

CONTRACT: *NXsa-59108. †N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
R-133	#R16-P5581-175 3300-394 325 016 #-633812-10 3Z7225-10	RESISTOR, variable composition; 250 ohms ±10%; 2 w, 70° C max continuous operation 3 tinned term; enclosed metal case 1 1/16″ diam x 9/16″ d; slotted metal shaft 0.250″ diam x 5/8″ min lg from mtg surface; linear taper; insulated contact arm, without off position normal torque; furnished w/1 nut and washer; bushing 3/8″-32 thd x 3/8″ lg 2 non-turn devices on 17/32″ rad at 3 and 9 o'clock, not used; must not contain materials which are nutrients for fungi resistant to salt spray.	D-c amplifier vert centering	AB 7713389 P-20 AB type "J" per Hazeltine Elec RM11SB251UK	Wemco 7613283 P-121 Hazeltine Elec RM11SB251UK
R-134*†	#R16-R-17354-5-100 #3300-381 169 000 # — #3RC20BF334J	RESISTOR, fixed; composition; 330,000 ohms ±5%; ½ w. *Used in all sets with serial numbers below 1169.*	Sweep freq	JAN type RC20BF334J	Spec JAN-R-11 Wemco 7613283 P-122 Hazeltine Elec RC20BF334J
R-134§	#R16-R-17352-1-13 #3300-381 168 160 # — #3RC20BF224J	RESISTOR, fixed: composition 220,000 ohms ±5%; ½ w. *Used in all sets with serial numbers above 1170.*	Sweep freq	JAN type RC20BF224J	Spec JAN-R-11 Hazeltine Elec RC20BF224J
R-135*	R16-P-5596-750 — — —	RESISTOR, variable: 1.0 megohm ±10%; 2 w; linear taper; case 1 1/16″ diam x 9/16″ thick; 3 terminals; shaft 0.250″ diam x 3/8″ long from 3/8″ bushing. *Used on all sets up to serial number 496.*	Sweep freq adjustment	AB 7713389 P-5 and P-15	Wemco 7613283 P-123
R-135	#R16-P-5597-37-175 3300-399 812 150 #-633813-M10 3Z7499-1B2	RESISTOR, variable: composition; 1.2 meg ±10%; 2 w, 70° C max continuous operation; 3 tinned term; enclosed metal case 1 1/16″ diam x 9/16″ d; round metal shaft 0.250″ diam x 3/4″ lg from mtg surface; linear taper; insulated contact arm, without off position; normal torque; mtg bushing 3/8″-32 thd x 3/8″ lg, 2 non-turn devices on 17/32″ rad at 3 and 9 o'clock, not used; resistant to salt spray. *Used on all sets with serial numbers above 496.*	Sweep freq adjustment	AB 7713389 P-23 AB type "J" per Hazeltine Elec PT-1049-2	Wemco 7613283 P-123 Hazeltine Elec PT-1049-2
R-136		RESISTOR, fixed: 100 ohms ±10%; same as R-126.	Sweep pl limiting		
R-137	#R16-R-17258-1-100 3300-381 167 940 # — 3RC20BF220K	RESISTOR, fixed: composition; 22 ohms ±10%; ½ w.	Sweep voltage gen	JAN type RC20BF220K	Spec JAN-R-11 Wemco 7613283 P-125 Hazeltine Elec RC20BF220K
R-138		RESISTOR, fixed: 33,000 ohms ±10%; same as R-123.	Sweep gen filter		
R-139		RESISTOR, fixed: 100,000 ohms ±10%; same as R-101.	Sweep gen filter		

R-140	#R16-P-5595-i31 3300-294 454 205 #-633811-10 2ZK7263-32	RESISTOR, variable: composition; 1 meg ±10%; 2 w, 70° C max continuous operation; 3 tinned term; enclosed metal case 1 1/16" diam x 9/16" d; slotted metal shaft 0.250" diam x 1" lg from mtg surface; linear taper; insulated cont arm, without off position; normal torque; furnished w/shaft locking nut; mtg bushing 3/8"-32 thd x 3/8" lg, 2 non-turn devices on 17/32" rad at 3 and 9 o'clock, not used; must not contain materials which are nutrients for fungi, resisant to salt spray.	Horiz sweep amplitude control	AB 7713389 P-11 AB type "J" per Hazeltine Elec RM11SE105UK	Wemco 7613283 P-128 Hazeltine Elec RM11SE105UK
R-141		RESISTOR, fixed: 100,000 ohms ±10%; same as R-101.	Sweep amplifier inverter grid leak		
R-142		RESISTOR, fixed: 47,000 ohms ±10%; same as R-114.	Horiz centering network		
R-143		RESISTOR, fixed: 22,000 ohms ±10%; same as R-105.	Horiz centering network		
R-144	#R16-P-5588-1-500 3300-298 380 364 #-633301-10 2Z27270.102	RESISTOR, variable: composition; 50,000 ohms ±10%; 2 w, 700° C max continuous operation; 3 tinned term; enclosed metal case 1 1/16" diam x 9/16" d; slotted metal shaft 0.250" diam x 1" min lg from mtg surface; linear taper; insulated contact arm, without off position; normal torque, furnished w/shaft locking nut; mtg bushing 3/8"-32 thd x 3/8" lg, 2 non-turn devices on 17/32" rad at 3 and 9 o'clock, not used; must not contain materials which are nutrients for fungi, resistant to salt spray.	Horiz centering control	AB 7713389 P-12 AB type "J" per Hazeltine Elec RM11SE503UK	Wemco 7613283 P-132 Hazeltine Elec RM11SE503UK
R-145		RESISTOR, fixed: 22,000 ohms ±10%; same as R-105.	Horiz centering network		
R-146		RESISTOR, fixed: 100,000 ohms ±10%; same as R-101.	Sweep amplifier inverter bias filter		
R-147		RESISTOR, fixed: 47,000 ohms ±10%; same as R-114.	Horiz centering network		
R-148		RESISTOR, fixed: 100,000 ohms ±10%; same as R-101.	Sweep amplifier inverter grid leak		
R-149	#R16-R-17403-500 #3300-381 168 240 # — #3RC20BF225K	RESISTOR, fixed: composition; 2.2 megohms ±10%; ½ w.	Sweep amplifier inverter grid coupling	JAN type RC20BF225K	Spec JAN-R-11 Wemco 7613283 P-137 Hazeltine Elec RC20BF225K

CONTRACT: *NXsa-59108. †N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
R-150	#R16-R-17347-10-25 #3300-381 316 220 #— #3RC30BF104K	RESISTOR, fixed: composition; 100,000 ohms ±10%; 1 w.	Sweep amplifier inverter pl load	JAN type RC30BF104K	Spec JAN-R-11 Wemco 7613283 P-138 Hazeltine Elec RC30BF104K
R-151		RESISTOR, fixed: 100,000 ohms ±10%; same as R-150.	Sweep amplifier inverter pl load		
R-152		RESISTOR, fixed: 150,000 ohms ±10%; same as R-111.	Sweep voltage divider		
R-153	#R16-P-5590-47 3300-298 380 443 #-631215-10 2Z7271-98	RESISTOR, variable: composition; 100,000 ohms ±10%; 2 w, 70° C max continuous operation; 3 tinned term; enclosed metal case 1 1/16" diam x 5/16" d; round metal shaft 0.250" diam x 3/4" min lg from mtg surface; linear taper; insulated contact arm, without off position; normal torque; mtg bushing 3/8"-32 thd x 3/8" lg, 2 non-turn devices on 17/32" rad at 3 and 9 o'clock, not used; must not contain materials which are nutrients for fungi; resistant to salt spray.	Spectrum width control	AB 7713389 P-16 AB type "J" per Hazeltine Elec RM11RC104UK	Wemco 7613284 P-146 Hazeltine Elec RM11RC104UK
R-154*	R16-R-17273-45 3300-381 168 060 — 3RC20BF222K	RESISTOR, fixed: 2200 ohms ±10%; 1/2 w; compound phenolic insulation; 3/8" long x 5/32" diam; wire leads 1 1/2" long. *Used on all sets below serial number 20.*	Sweep voltage divider	AWS type RC20BF222K	Spec AWS C75.7 Wemco 7613284 P-147
R-154	#R16-R-17264-138-25 #3300-381 166 100 #— #3RC20BF102K	RESISTOR, fixed: composition; 1000 ohms ±10%; 1/2 w. *Used on all sets above serial number 20.*	Sweep voltage divider	JAN type RC20BF102K	Spec JAN-R-11 Wemco 7613284 P-147 Hazeltine Elec RC20BF102K
R-155	#R16-R-17354-14-143 3300-381 169 840 #— 3RC20BF474J	RESISTOR, fixed: composition; 470,000 ohms ±5%; 1/2 w.	Blanking (back-trace suppressor) grid	JAN type RC20BF474J	Spec JAN-R-11 Wemco 7613284 P-148 Hazeltine Elec RC20BF474J

R-156		RESISTOR, fixed: 100,000 ohms ±10%; same as R-101.	Blanking (back-trace suppressor) grid bias filter		
R-157		RESISTOR, fixed: 100,000 ohms ±10%; same as R-150.	Blanking (back-trace suppressor) pl supply filter		
R-158	#R16-R-17310-59-50 3300-381 167 140 #— 3RC20BF153K	RESISTOR, fixed: composition; 15,000 ohms ±10%; ½ w.	Blanking (back-trace suppressor) pl load	JAN type RC20BF153K	Spec JAN-R-11 Wemco 7613284 P-151 Hazeltine Elec RC20BF153K
R-159		RESISTOR, fixed: 47,000 ohms ±10%; same as R-114.	Blanking (back-trace suppressor) grid coupling		
R-160		RESISTOR, fixed: 47,000 ohms ±10%; same as R-114.	Intensifier cathode		
R-161		RESISTOR, fixed: 470,000 ohms ±5%; same as R-155.	Intensifier grid filter		
R-162		RESISTOR, fixed: 33,000 ohms ±10%; same as R-123.	Intensifier grid filter		
R-163*	— — -633814-10 —	RESISTOR, variable: 25,000 ohms ±10%; linear taper, 2 w; case 1.227″ diam x 9/16″ thk; 3 terminals; shaft 0.250″ diam x 1 3/16″ lg from 3/8″ bushing.	Oscilloscope intensity control	Stackpole 7713389 P-7	Wemco 7613284 P-156
R-163§	R16-P-5586-180 3300-294 459 605 -636916-10 2Z7270-20	RESISTOR, variable: composition; 25,000 ohms ±10%; 2 w, 70° C max continuous operation; 3 solder lug term; enclosed metal case 1 1/16″ diam x 9/16″ d; special shaft 0.250″ diam x 1 19/32″ lg, incl mtg bushing; metal portion 1/16″ lg with nylon laminate MEC-1 extension; linear taper; 3/8″-32 thd x 3/8″ lg mtg bushing; insulated contact arm, without off position; normal troque; 2 non-turn devices on 17/32″ rad at 3 and 9 o'clock not used.	CRT intensity control	Hazeltine Elec A-4088-2	Hazeltine Elec A-4088-2
R-164		RESISTOR, fixed: 100,000 ohms ±10%; same as R-101.	Neg supply divider		
R-165*	— — -633808-10 —	RESISTOR, variable: 250,000 ohms ±10%, linear taper, 2 w; case 1.227″ diam x 9/16″ thk; 3 terminals; shaft 0.250″ diam x 1 3/16″ lg from 3/8″ bushing.	Oscilloscope focus control	Stackpole 7713389 P-8	Wemco 7613284 P-158

CONTRACT: *NXsa-59108. N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
R-165§	R16-P-5593-38-900 3300-399 811 505 -636915-10 3Z7498-25-25	RESISTOR, variable: composition; 250,000 ohms ±10%; 2 w, 70° C max continuous operation; 3 solder lug term; enclosed metal case 1 1/16″ diam x 9/16″ d; special shaft 0.250″ diam x 1 19/32″ lg incl mtg bushing; metal portion 1/16″ lg with nylon laminate MEC-1 extension; linear taper; insulated contact arm, without off position; normal torque; 3/8″-32 thd x 3/8″ lg mtg bushing; 2 non-turn devices on 17/32″ rad at 3 and 9 o'clock not used.	CRT focus control	Hazeltine Elec A-4087-2	Hazeltine Elec A-4087-2
R-166		RESISTOR, fixed: 47,000 ohms ±10%; same as R-114.	Neg supply divider		
R-167		RESISTOR, variable: 100,000 ohms ±10%; same as R-153.	Spectrum centering control		
R-168		RESISTOR, fixed: 47,000 ohms ±10%; same as R-114.	Neg supply divider		
R-169	#R16-R-17354-14-63 3300-381 169 560 # — 3RC20BF434J	RESISTOR, fixed: compositon; 430,000 ohms ±5%; ½ w.	Neg supply divider	JAN type RC20BF434J	Spec JAN-R-11 Wemco 7613284 P-162 Hazeltine Elec RC20BF434J
R-170	#R16-R-17337-23 3300-381 170 020 # — 3RC20BF513J	RESISTOR, fixed: composition; 51,000 ohms ±5%; ½ w.	Neg supply divider	JAN type RC20BF513J	Spec JAN-R-11 Wemco 7613284 P-163 Hazeltine Elec RC20BF513J
R-171		RESISTOR, fixed: 15,000 ohms ±10%; same as R-158.	Neg supply divider		
R-172		RESISTOR, fixed: 47,000 ohms ±10%; same as R-114.	Neg supply filter		
R-173*		RESISTOR, fixed: 10,000 ohms ±10%; 2 w; compound, phenolic insulation, 1 3/8″ long x 3/8″ diam, wire leads 1½″ long.	Pos supply filter	AWS type RC40BF103K	Spec AWS C75.16 Wemco 7613284 P-166
R-173A§	#R16-R-17310-178 3300-381 518 100 # — 3RC40BF203J	RESISTOR, fixed: composition; 20,000 ohms ±5%; 2 w.	Pos supply filter	JAN type RC40BF203J	Spec JAN-R-11 Hazeltine Elec RC40BF203J
R-173B§		RESISTOR, fixed: 20,000 ohms ±5%; same as R-173A.	Pos supply filter		

R-174*	R16-P-5590-150 — — —	RESISTOR, variable: 100,000 ohms ±10%; linear taper, 2 watts; case 1 1/16" diam x 9/16" thick; 3 terminals; shaft 0.250" diam x 9/16" long from 3/8" bushing, with screwdriver slot. *Used on all sets up to serial number 165.*	Spot adjustment	AB 7713389 P-3 or P-13	Wemco 7613284 P-167
R-174	#R16-P-5593-38-600 3300-298 380 863 #-633810-10 2Z7272-99	RESISTOR, variable: composition; 250,000 ohms ±10%; 2 w, 70° C max continuous operation; 3 tinned term; enclosed metal case 1 1/16" diam x 9/16" d; slotted metal shaft 0.250" diam x 1" min lg from mtg surface; linear taper; insulated contact arm, without off position; normal torque; furnished w/ shaft locking nut; mtg bushing 3/8"-32 thd x 3/8" lg, 2 non-turn devices on 17/32" rad at 3 and 9 o'clock, not used. *Used on all sets above serial 165.*	Spot adjustment	AB 7713389 P-24 AB type "J" per Hazeltine Elec RM11SE254UK	Wemco 7613284 P-167 Hazeltine Elec RM11SE254UK
R-175*	R16-R-17339-8-500 3300-381 320 640 — 3RC30BF683K	RESISTOR, fixed: 68,000 ohms ±10%; 1 watt, compound, phenolic insulation, 11/16" long x 1/4" diam, wire leads 1 1/2" long. *Not used in sets above serial number 165.*	Voltage divider osc pl	AWS type RC30BF683K	Spec AWS C75.7 Wemco 7613284 P-168
R-175§		Not used in sets with serial numbers above 1001.			
R-176		RESISTOR, fixed: 330,000 ohms ±10%; same as R-112.	Voltage reg grid		
R-177		RESISTOR, fixed: 1000 ohms ±10%; same as R-154.	Voltage reg screen		
R-178		RESISTOR, fixed: 1 meg ±10%; same as R-119.	Voltage reg divider		
R-179		RESISTOR, fixed: 1 meg ±10%; same as R-119.	Voltage reg divider		
R-180		RESISTOR, fixed: 150,000 ohms ±10%; same as R-111.	Voltage reg divider		
R-181		RESISTOR, fixed: 33,000 ohms ±10%; same as R-123.	Voltage reg divider		
R-182		RESISTOR, variable: 50,000 ohms ±10%; same as R-144.	Pos supply voltage adjustment		
R-183		RESISTOR, fixed: 22,000 ohms ±10%; same as R-105.	Voltage reg divider		
R-184		RESISTOR, fixed: 1 meg ±10%; same as R-119.	R-f osc pl coupling		
R-185		RESISTOR, fixed: 22,000 ohms ±10%; same as R-105.	D-c amplifier screen divider		
R-186		Not used.			
R-187		Not used.			
R-188	#R16-R-17349-10-25 3300-381 317 200 # — 3RC30BF154K	RESISTOR, fixed: composition; 150,000 ohms ±10%; 1 w.	Voltage divider CRT pl	JAN type RC30BF154K	Spec JAN-R-11 Wemco 7613284 P-181 Hazeltine Elec RC30BF154K

CONTRACT: *NXsa-59108. N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
R-189		RESISTOR, fixed: 150,000 ohms ±10%; same as R-188.	Voltage divider CRT pl		
R-190	#R16-R-17384-500 3300-381 167 260 # — 3RC20BF155K	RESISTOR, fixed: composition; 1.5 meg ±10%; ½ w.	Detector bias filter	JAN type RC20BF155K	Spec JAN-R-11 Wemco 7613284 P-183 Hazeltine Elec RC20BF155K
R-191		RESISTOR, fixed: 1.5 meg ±10%; same as R-190.	Detector bias filter		
R-192		RESISTOR, fixed: 33,000 ohms ±10%; same as R-123.	Intensifier grid filter		
R-193	#R16-P-5581-172-400 3300-394 325 016 # — 3Z7225-10	RESISTOR, variable: composition; 250 ohms ±10%; 2 w, 70° C max continuous operation; 3 tinned term; enclosed metal case 1 1/16" diam x 9/16" d; slotted metal shaft 0.250" diam x 1" min lg from mtg surface; linear taper; furnished w/shaft locking nut; insulated contact arm, without off position; normal torque; mtg bushing 3/8"-32 thd x 3/8" lg, 2 non-turn devices on 17/32" rad at 3 and 9 o'clock, not used; must not contain materials which are nutrients for fungi, resistant to salt spray.	Filter center tap adjustment	AB type "J" per Hazeltine Elec RM11SE251UK	Hazeltine Elec RM11SE251UK
R-194		RESISTOR, fixed: 1000 ohms ±10%; same as R-154.	Video amplifier decoupling		
R-195*	R16-R-17279-1-12 3300-381 318 880 — 3RC30BF332K	RESISTOR, fixed: composition; 3300 ohms ±5%; 1 w; max dimen 0.718" lg x 0.280" diam; phenolic insulation; two axial wire leads 1½" lg. *Used in all sets up to serial number 490.*	I-f screen supply divider	AWS type RC30BF332J	Spec AWS C75.7 Wemco 7613284 P-188
R-195	#R16-R-17264-750 3300-381 316 100 # — 3RC30BF102K	RESISTOR, fixed: composition; 1000 ohms ±10%; 1 w. *Used in all sets above serial number 490.*	I-f screen supply divider	JAN type RC30BF102K	Spec JAN-R-11 Wemco 7613284 P-188 Hazeltine Elec RC30BF102K
R-196		RESISTOR, fixed: 10,000 ohms ±5%; same as R-102.	1st i-f screen filter		

R-197*	— — -633809-10 —	RESISTOR, variable: 5000 ohms ±10%; linear taper, 2 w. Case 1.227″ diam x 9/16″ thk max dimen, 3 terminals; shaft 0.250″ diam x 9/16″ lg from 3/8″ bushing with screwdriver slot.	Sensitivity control	AB 7713389 P-28	Wemco 7613289 P-190
R-197§	#R16-P-5583-7-900 3300-298 380 065 #-636123-P10 2Z7269.44	RESISTOR, variable: composition; 5000 ohms ±10%; 2 w, 70° C max continuous operation; 3 solder lug term; enclosed metal case 1 1/16″ diam x 9/16″ d; slotted metal shaft 0.250″ diam x 7/8″ lg from mtg surface; linear taper; insulated contact arm, without off position; normal torque; furnished w/shaft locking nut; bushing 3/8″-32 thd x 3/8″ lg, 2 non-turn devices located on 17/32″ rad at 3 and 9 o'clock one used.	Sensitivity control	AB type "J" per Hazeltine Elec RM11SD502UK	Hazeltine Elec RM11SD502UK
S-101*	— — -24440 —	SWITCH, toggle: DPST, 1 3/32″ x 11/16″ x 21/32″, with 15/32″-32 bushing 15/32″ lg, 4 lugs.	Power on-off sw	C-H 8370K2	Wemco 7613284 P-193
S-101§	#R17-S-28233-60 3300-395 853 600 # — 3Z9863-52K	SWITCH, toggle: DPST, 2 position; 30 amp at 30 v DC; bakelite body; max dimen of body 2 7/32″ lg x 1 21/64″ wd x 49/64″ thk; 11/16″ lg bat type handle; ON-OFF locking action, normally open; 4 solder lug term; single hole mtg bushing 15/32″-32, 15/32″ lg, incl 2 hex nuts and lock washer.	Power on-off sw	JAN type ST52K	Spec JAN-S-23 Hazeltine Elec SW-1097-2
S-102*	— — -24752 —	SWITCH, toggle: SPST, 1 3/32″ x 43/64″ x 11/16″, with 15/32″-32 bushing 15/32″ lg, 2 lugs.	Sync sw	C-H 8381K3	Wemco 7613284 P-194
S-102§	#R17-S-28254-50 3300-395 853 395 # — 3Z9863-42A	SWITCH, toggle: SPST, 2 position; 40 amp at 30 v DC; phenolic body; max dimen of body 2 7/32″ lg x 1 9/64″ wd x 41/64″ thk, o/a; lever type handle 1 5/32″ lg; OFF-ON, locking, normally closed; 2 solder lug term; single hole mtg bushing 15/32″-32, 15/32″ lg, furnished with mtg/hardware.	Sync sw	JAN type ST42A	Spec JAN-S-23 Hazeltine Elec SW-10011-2
S-103	#R16-S-11279-580 3300-397 502 134 — 3Z9825-71.15	SWITCH, rotary: 2 pole, 5 position; single sect; spring silver alloy cont; ceramic wafer; body 1 7/8″ wd x 2 13/16″ h x 1 3/8″ d overall; non-shorting cont; normally closed; 12 solder lug term, 3 not used; single hole mtg bushing 3/8″-32 thd x 3/8″ lg, shaft 0.250″ diam x 1 7/8″ lg, from bushing, with 2 flats 5/8″ lg x 1/32″ d, located 120 deg apart; furnished w/mtg hardware; permanent stops for #3 and #5 positions.	D-c amplifier video sel sw	Centralab 7713876 P-1 Centralab per Haz SW-1099	Wemco 7613284 P-195 Hazeltine Elec SW-1099
T-101	R16-WX-7713258-G3 3300-308 415 910 -472268 3C1084Z25	TRANSFORMER, RF: RF input; two windings, single layer wound; shielded; pri 1 1/4 turns and secd 17 3/4 turns #32 AWG wire; iron core; cylindrical bakelite case 1 1/16″ diam x 1 21/32″ d o/a; permeability tuned by tuning wrench; single hole mtg bushing 3/8″-32 thd x 1/4″ lg; 4 solder lug term on side; incl hex head nut and lockwasher; 3.5 μh to 8 μh inductance range.	I-f input transf	Wemco 7713258 G-3 Hazeltine Elec A-4010-3	Wemco 7613284 P-199 Hazeltine Elec A-4010-3

CONTRACT: *NXsa-59108. N383s-1427. N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
T-102*	— — -302672 —	TRANSFORMER, power: 50/1200 cycles, 115 volts primary; secondary voltages: 6.3 volts at 0.6 amps, 2.5 volts at 1.75 amps, 6.3 volts at 4.83 amps, 6.3 volts at 1.25 amps, 5.0 volts at 2.0 amps, 1045 volts at .005 amps, 650-0-650 volts at .075 amps, 15 terminals and 4 mounting feet.	Power supply +300 V.D.C. —1000 V.D.C.	Wemco L-423172	Wemco 7613284 P-200
T-102§	R16-WX-L423172 3300-296 937 649 -304646 2Z9619-159	TRANSFORMER, power: plate and filament type; input 115 v, 50-1200 cps, single ph; 5 secd windings; secd #1, term #1-2: 6.3 v at 0.6 amps; secd #2 tapped winding, term #3-4: 2.5 v at 1.75 amps, term #4-5: 438 v at .003 amps, term #5-7: 1450 v CT at .07 amp, term #6 gnd CT; secd #3: 6.3 v at 4.8 amp; secd #4: 6.3 v at 1.25 amps; secd #5: 5 v at 2 amp; pri input term #14-15: 115 v at 1.1 amps; 2000 v ins test; oil filled; coil and core mtd on open frame; fosterite finish per Wemco, or flexseal finish per WECo; 3 5/8" sq x 4 5/8" h excl mtg bkt; 13 solder lug and two #8-32 thd screw term studs on bottom; four mtg foot bkts, ea w/0.187" diam hole on 4 3/8" x 2 7/8" mtg/c; electrostatic shield between pri and secd gnd to case; impregnated for tropical use.	Power supply +300 V.D.C. —1000 V.D.C.	Freed Trans per Haz TR-1103	Hazeltine Elec TR-1103
V-101	#16-T-5665 #3300-234 725 000 # #2J6SJ7	TUBE, electron: RF pentode, sharp cutoff.	1st IF	JAN type 6SJ7	Spec JAN-1A Wemco 7613284 P-203 Hazeltine Elec TU-10016
V-102	#16-T-56611 #3300-234 665 000 # #2J6SA7	TUBE, electron: pentagrid converter, receiving.	Converter, 22.5 Mc to 3 Mc	JAN type 6SA7	Spec JAN-1A Wemco 7613284 P-204 Hazeltine Elec TU-10035
V-103	#16-T-56682 #3300-234 754 850 # #2J6SN7	TUBE, electron: twin triode.	Includes V-103A, V-103B	JAN type 6SN7/GT	Spec JAN-1A Wemco 7613284 P-205 Hazeltine Elec TU-10018
V-103A		TUBE, electron: part of V-103.	Detector		

V-103B		TUBE, electron: part of V-103.	Voltage reg		
V-104	#16-T-56138 #3300-234 435 000 #— #2J6AC7	TUBE, electron: sharp cutoff RF pentode.	Video amplifier	JAN type 6AC7	Spec JAN-1A Wemco 7613284 P-206 Hazeltine Elec TU-10028
V-104††		TUBE, electron: sharp cutoff RF pentode; ruggedized.	Video amplifier	JAN type 6AC7W	Spec JAN-1A Hazeltine Elec TU-10076
V-105	#16-T-53250 #3300-234 245 000 #— #2J3BP1A	TUBE, electron: electrostatic deflection and focus cathode-ray.	Indicator	JAN type 3BP1A	Spec JAN-1A Wemco 7613285 P-217 Hazeltine Elec TU-1039
V-106		TUBE, electron: same as V-101.	D-c amplifier		
V-107	#16-T-68840 #3300-235 630 000 #— #2J884	TUBE, electron: thyratron, gas triode.	Sweep gen	JAN type 884	Spec JAN-1A Wemco 7613285 P-219 Hazeltine Elec TU-10042
V-108		TUBE, electron: same as V-103.	Sweep amplifier inverter		
V-109		TUBE, electron: same as V-103.	Blanking (back-trace suppressor) and intensifier		
V-110	#16-T-52820 #3300-234 205 001 #— #2J2X2A	TUBE, electron: high voltage vacuum rectifier.	Neg supply rect	JAN type 2X2A	Spec JAN-1A Wemco 7613285 P-222 Hazeltine Elec TU-10026
V-111	#16-T-55444 #3300-234 355 000 #— #2J5R4GY	TUBE, electron: full-wave high-vacuum rectifier, receiving.	Pos supply rect	JAN type 5R4GY	Spec JAN-1A Wemco 7613285 P-223 Hazeltine Elec TU-10021

CONTRACT: *NXsa-59108. N383s-1427. ††N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG. or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
V-112	#16-T-56961 #3300-234 820 000 # — #2J6Y6G	TUBE, electron: beam power-amplifier.	+300 v reg control	JAN type 6Y6G	Spec JAN-1A Wemco 7613285 P-224 Hazel ine Elec TU-10041
V-113		TUBE, electron: same as V-101.	+300 v reg control		
V-114	#17-L-6811 #3300-235 705 000 # — #2J991	TUBE, electron: neon.	+300 v reg control	RCA type 991	Spec JAN-1A Wemco 7613285 P-226 Hazeltine Elec TU-1020
V-115	#16-T-52625 #3300-234 198 985 or #3300-235 400 700 # — #2J2K25 or #2J723A/B	TUBE, electron: klystron, integral cavity.	R-f osc	JAN type 2K25 WECo 2K25 or 723A/B	Spec JAN-1A Wemco 7613285 P-227 Hazeltine Elec TU-1080
V-116		TUBE, electron: same as V-114.	Voltage regulated neg supply		
V-117		TUBE, electron: same as V-114.	Voltage regulated neg supply		
V-118		TUBE, electron: same as V-114.	Voltage regulated neg supply		
W-101*		CABLE: Single conductor, double shielded, polyethylene insulation and vinylite jacket, with 90° connector (P-101) at one end.	Crystal mixer to input transf	Wemco 7415327 G-1	Wemco 7613285 P-236
W-101§	# — #3300-150 424 100 # — #1F425-5.8	CABLE ASSEMBLY, RF: uses AN type RG-5/U cable; 8″ lg excluding terminations; AN type UG-276/U receptacle connector, P-101, one end, stripped shielding ⅜″ lg, dielectric ⅛″ lg cond ½″ lg other end; (includes P-101, W-101A§).	Crystal mixer to input transf	Hazeltine Elec A-3957	Hazeltine Elec A-3957

W-101A§	# — #3300-132 335 567 #RG-5/U #1F425-5	CABLE, RF: coaxial; characteristic impedance 52.5 ohms; operating, 3,000 v RMS; inner cond, #16 AWG solid plain copper wire; outer cond, double braid, outer and inner braid #34 plain copper wire; solid dielectric, type "A"; type I synthetic resin jacket; (part of W-101§).	Cable for W-101	AN type RG-5/U	Spec JAN-C-17A Hazeltine Elec CA-2014
W-201*	— 1600-322 975 227 CX-337/U 3E6000-337	CABLE: Type "SJ" cable, #18 wire, with 2 blade plug at one end and 2 contact receptacle at other end, approx. 10 feet total length, CX-337/U.	Power cable	Wemco 7415325 G-1	Wemco 7613392 P-21
W-201§	# — #1600-324 759 988 #CX-337/U(6′) #3E6000-337-72	CABLE ASSEMBLY, power: 6′ two cond cable Navytype DCOP-2; female plug, Belden type H-1119 one end, male plug, Belden type H-1047 other end; (incl P-201, P-202, W-201A§).	Power cable	Belden #5070A	Hazeltine Elec A-3963
W-201A§	# — #8800-087985 # — # —	CABLE, power: Navy type DCOP-2; 2 cond; dielectric strength 1500 v AC, 60 cps for 5 min; ea cond 21 strands copper wire 0.005 diam; ea cond wall consists of 85% rubber; cond twisted together by cotton braided tie cord; tough rubber sheath 0.250″ diam max; (part of W-201§).	Cable for W-201	Hazeltine Elec CA-10151	Hazeltine Elec CA-10151
W-202*†	# — #1600-322 975 597 #CX-464/UP(4′) #3E6000-464	CABLE ASSEMBLY, special purpose; 4 ft two cond cable Navy type DCOP-2; 2 cond telephone plugs ea end, Telephonics type PL-55; (incl P-203, P-204, W-202A).	Mixer cable	Wemco 7415326 G-1 Hazeltine Elec A-3958	Wemco 7613392 P-23 Hazeltine Elec A-3958
W-202††		CABLE ASSEMBLY, special purpose: uses Navy Type DCOP-1 cable, 51″ lg o/a; terminated by one Hazeltine Elec, telephone type, plug PL-1090 each end; (incl P-203††, P-204††, W-202A†‡).	Mixer Cable	Hazeltine Elec A-3958	Hazeltine Elec A-3958
W-202A*	— 3300-111 993 000 — 1B818-14	CABLE: Type "SJ", #18 wire, one conductor covered with white vinylite, the other with black vinylite, then both covered with black vinylite.	Conductor for W-202	Amphenol, Anaconda, Fed Tel & Rad type SJ	Wemco 7613392 P-24
W-202A†		CABLE, RF: same as W-201A§; part of W-202*†.			
W-202A††		CABLE, special purpose; uses Navy Type DCOP-1; 2 cond; dielectric strength 1000 v AC, ea cond 10 strands copper wire 0.010″ diam; ea cond wall consists of 85% rubber; cond twisted together by cotton braided tie cord; tough rubber sheath 0.250″ diam max (p/o W-202††).		Hazeltine Elec DCOP-1	Hazeltine Elec DCOP-1
W-203*	— 1600-154 431 000 CG-92/U 1F430-92.72	CABLE ASSEMBLY: Consisting of cable (W-203A) and connectors (P-205* and P-206*).	Antenna horn cable	Wemco 7415328 G-1	Wemco 7613392 P-25
W-203§	# — #1600-154 431 040 #CG-92A/U(6′) #1F430-921A.72	CABLE ASSEMBLY, RF: uses AN Type RG-9/U RF coaxial cable; assem 73″ lg o/a; 69¼″ excluding terminations; terminated by AN type plug UG-21B/U each end; (incl W-203A, P-205§, P-206§).	Antenna horn cable	Hazeltine Elec A-3954	Hazeltine Elec A-3954

CONTRACT: *NXsa-59108. †N383s-1427. ††N383s-45628. §N383s-1427 & N383s-45628.

TABLE 6-2. TABLE OF REPLACEABLE PARTS (Continued)

MODEL: SPECTRUM ANALYZER TS-148/UP

MAJOR ASSEMBLY: SPECTRUM ANALYZER TS-148/UP

Reference Symbol	ASO Stock Number USAF Stock Number Navy Type Number SigC Stock Number	Name of Part and Description	Function	MFR. and DESIG or JAN or AWS TYPE	CONT. or GOVT. DWG. or SPEC. No.
W-203A*	— 3300-150 425 190 RG-9/U 1F425-9	CABLE: single conductor, double shielded, polyethylene insulation and vinylite jacket; (p/o W-203*).	Coaxial cable for W-203*	AN type RG-9/U Amphenol, Anaconda, Fed Tel & Rad	Wemco 7613392 P-26
W-203A§	# — #3300-150 425 190 #RG-9/U #1F425-9	CABLE, RF: coaxial; characteristic impedance 51 ohms; 10,000 v RMS; inner cond, 7 strands #21 AWG bare copper wire; outer cond, inner braid 24 strands #34 AWG silver-coated copper wire, outer braid 24 strands #34 AWG plain copper wire; solid dielectric, stabilized polyethylene; vinyl type II non-contaminating synthetic resin jacket 0.420″ diam; (part of W-203§).	Coaxial cable for W-203§	AN type RG-9/U	Hazeltine Elec CA-1234
X-101	#R16-S-6188-10 #3300-295 840 500 #-49351-B #2Z8654.7	SOCKET, tube: std octal; retainer ring mtg; 1 1/8″ diam chassis cut-out required; round, mica filled bakelite body, 1 1/4″ diam x 1/2″ h less term, one 5/16″ diam hole through center; spring brass cont, silver pl; retainer ring included.	Socket for V-101	Amphenol #78-S8-T	Wemco 7613285 P-240 Hazeltine Elec SO-1056
X-102		SOCKET, tube: same as X-101.	Socket for V-102		
X-103		SOCKET, tube: same as X-101.	Socket for V-103		
X-104		SOCKET, tube: same as X-101.	Socket for V-104		
X-105	#R16-S-6189-230 #3300-295 964 605 #-49920 #2Z8684-14	SOCKET, tube: 14 spring clip cont; term #4, #6, #12, and #13 not used; pressure spring clip cont mtg; for C-R tube, mts horiz on chassis; round, mica filled bakelite body, 2 7/32″ diam x 1 1/8″ h, one 25/32″ diam hole through center; brass cont, silver pl; term lugs imbedded in 7/32″ diam hole cavities.	Socket for V-105	Cinch #9453	Wemco 7613285 P-244 Hazeltine Elec SO-1061
X-106		SOCKET, tube: same as X-101.	Socket for V-106		
X-107	#R16-S-6187 #3300-295 956 881 #-4[illegible]374-A #2[illegible]8678.226	SOCKET, tube: std octal; 2 term not used; steel mtg saddle; two 5/32″ diam mtg holes on mtg saddle 1 1/2″ c to c; 1 9/64″ diam chassis cut-out required; round, mica filled bakelite body, 1 7/64″ diam x 1/2″ h, less term; spring brass cont, silver pl.	Socket for V-107	Amphenol #77-MIP-8TM	Wemco 7613285 P-246 Hazeltine Elec SO-1059
X-108		SOCKET, tube: same as X-101.	Socket for V-108		
X-109		SOCKET, tube: same as X-101.	Socket for V-109		

X-110	#R16-S-4531 3300-295 944 500 #-49410 2Z8674.18	SOCKET, tube: 4 spring clip cont; 2 term not used; steel mtg saddle w/retainer ring; two 5/32" diam mtg holes on mtg saddle 1 25/32" c to c, 1 5/16" diam chassis cut-out required; round, mica filled bakelite body, 1 1/4" diam x 1/2" h less term; brass cont, silver pl; retainer ring included.	Socket for V-110	Amphenol #78-RS-4TM	Wemco 7613285 P-249 Hazeltine Elec SO-1058
X-111	#R16-S-6187-25 3300-296 249 500 #-491114 2Z8795.13	SOCKET, tube: std octal; 4 term not used; steel mtg saddle w/retainer ring; two 5/32" diam mtg holes on mtg saddle 1 25/32" c to c, 1 1/2" diam chassis cut-out required; round, mica filled bakelite body, 1 1/4" diam x 1/2" h less term, one 5/16" diam hole through center; spring brass cont, silver pl; retainer ring included.	Socket for V-111	Amphenol #78-RS-8TM	Wemco 7613285 P-250 Hazeltine Elec SO-1057
X-112		SOCKET, tube: same as X-111.	Socket for V-112		
X-113		SOCKET, tube: same as X-101.	Socket for V-113		
X-114	#R-17-H-5974-150 3300-292 334 525 #-491116 2Z5886-5	SOCKET, tube: 2 miniature cont; shell and mtg saddle, brass, nickel pl; one piece mtg saddle; two 0.152" diam mtg holes on 1 1/8" mtg/c; round phenolic insert; phosphor bronze silver pl cont; two key slots in shell bayonet mtg, incl 2 solder tinned term for wire connection.	Socket for V-114	Millen 7411241 P-1 Millen #33991	Wemco 7613285 P-253 Hazeltine Elec SO-1052
X-115	#R16-S-4518 3300-295 956 905 #-491117 2Z8678.250	SOCKET, tube: std octal modified; #3, #4, #5, and #6 spring clip cont removed; flush mtd in wave guide, fixed attenuator end, held by one #4-40 thd screw 9/16" lg; 1 7/16" diam chassis cut-out required; round, mica filled bakelite body, 1 1/4" diam x 1/2" less term, one 5/16" diam hole through center; spring brass cont, silver pl; incl three #22 AWG wire leads.	Socket for V-115	Maguire Ind A2860 Suffolk Prod per Haz A-4173	Wemco 7613285 P-254 Hazeltine Elec A-4173
X-116		SOCKET, tube: same as X-114.	Socket for V-116		
X-117		SOCKET, tube: same as X-114.	Socket for V-117		
X-118		SOCKET, tube: same as X-114.	Socket for V-118		
Z-101	#R16-AN-CG-176/AP #1600-327 213 750 #CG-176/AP #3F3950-176	CONNECTOR, wave guide: two hole directional coupler, wave guide selector type; 20 db nominal impedance, directivity 39.29 db; 5" lg x 2 1/4" hx 2 1/4" wd overall; inscribed 20 db nominal, CG-176/AP, TO TRANSMITTER w/arrow sign; incl pick-up coupling connector w/female cont, 5/8"-24 ext thd for connection to "N" type cable connectors, coupling connector 1 41/64" sq ea end w/four #8-32 tapped mtg holes on 1.281" x 1.218 mtg/c, brass unit w/flat black wrinkle finish; not furnished on equipment with serial numbers 1 through 817, inclusive.	Directional wave guide coupler	Hazeltine Elec A-4297 AN type CG-176/AP	Hazeltine Elec A-4297

AN 16-35TS148-5

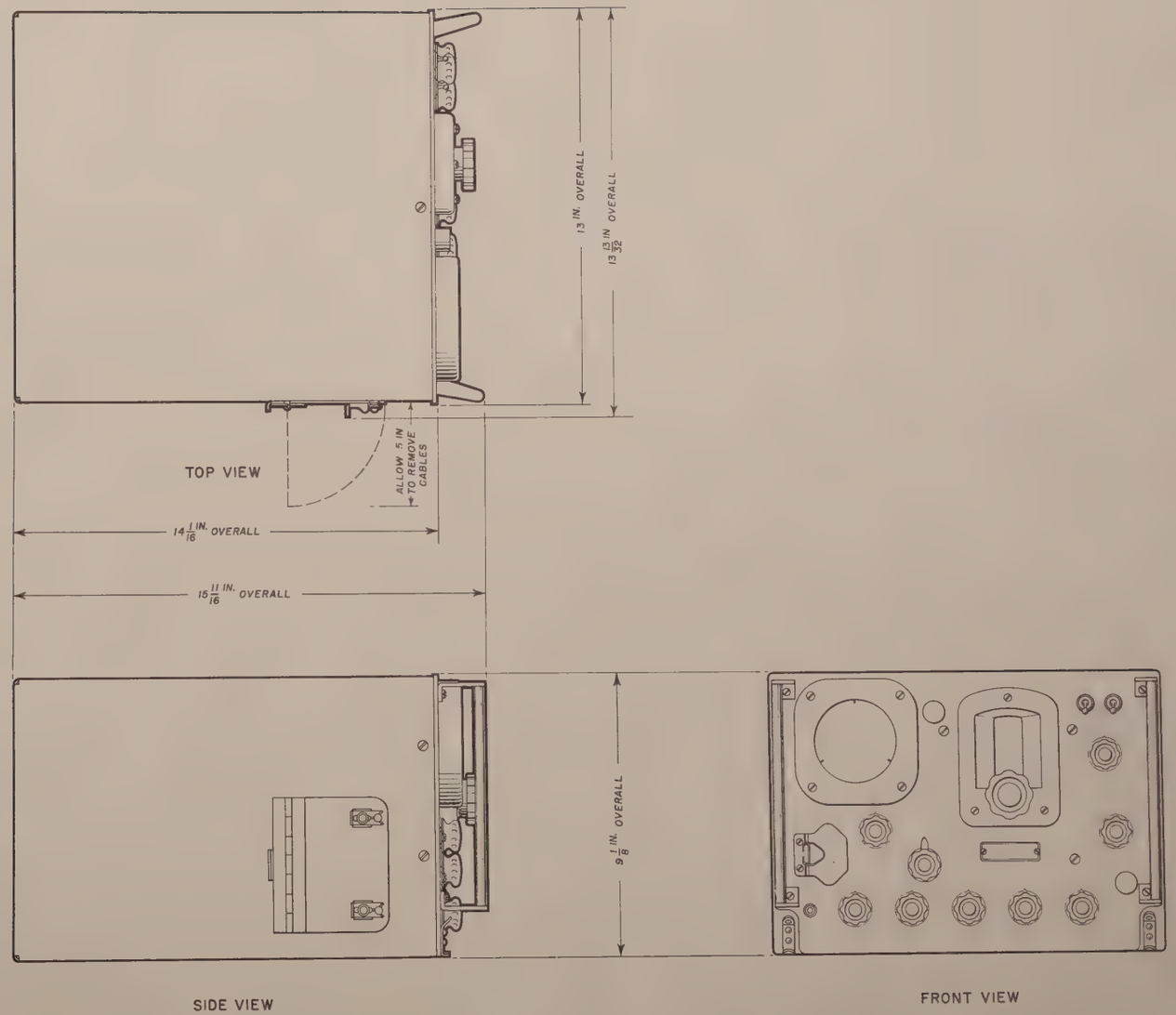
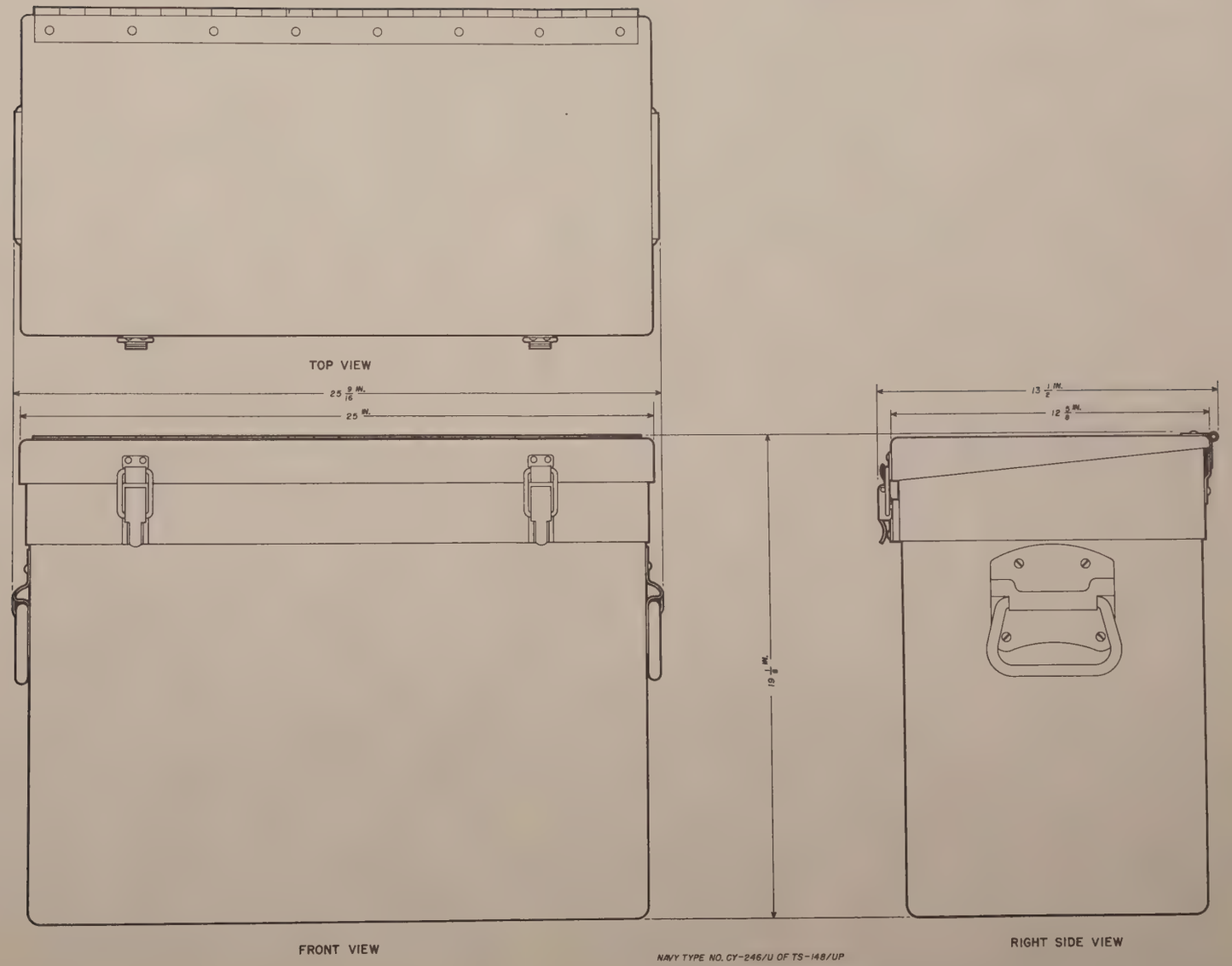


Figure 7-1. Spectrum Analyzer, Outline Drawing (Dwg. 7613837)

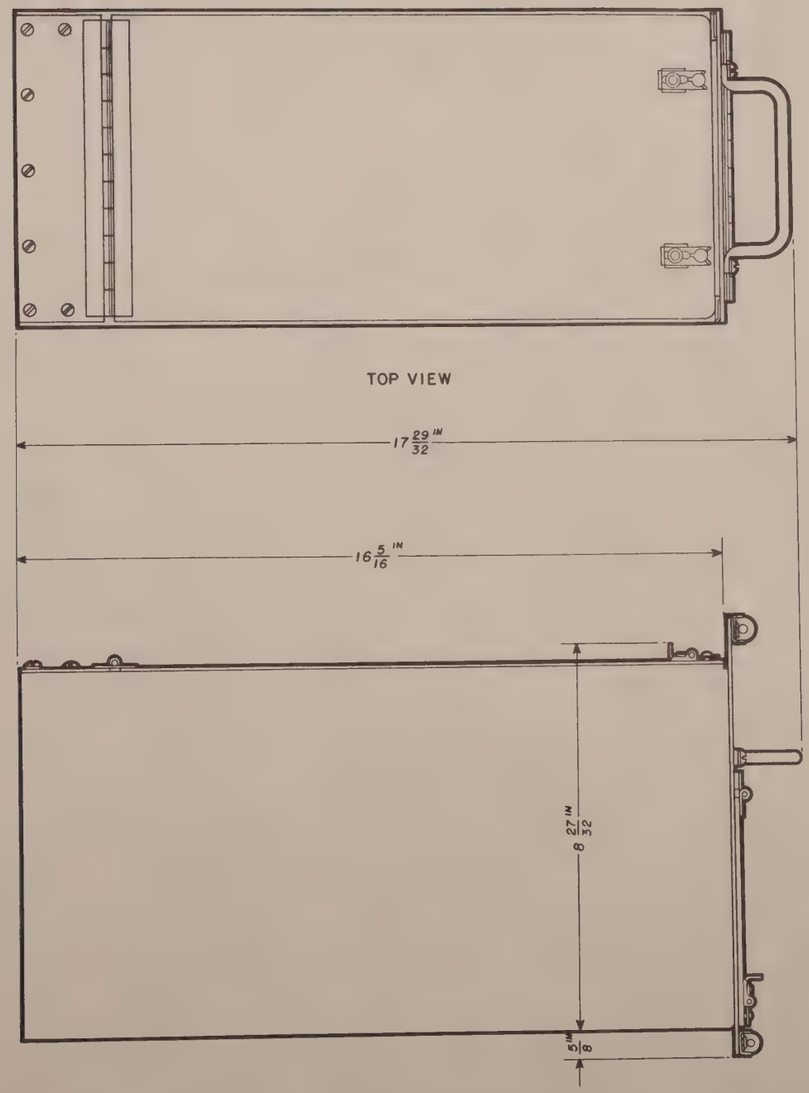
AN 16-35TS148-5

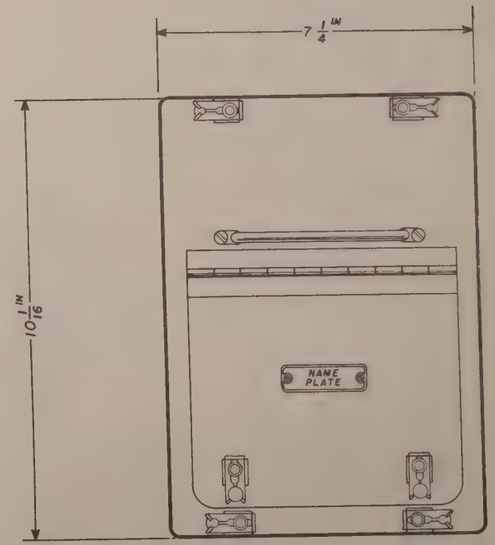


NAVY TYPE NO. CY-246/U OF TS-148/UP

Figure 7-2. Carrying Case, Outline Drawing (Dwg. 7613835)

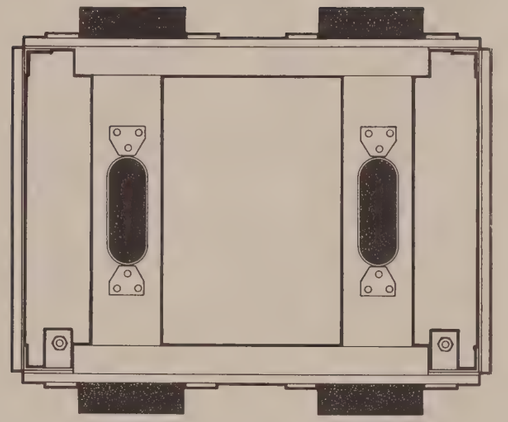
AN 16-35TS148-5



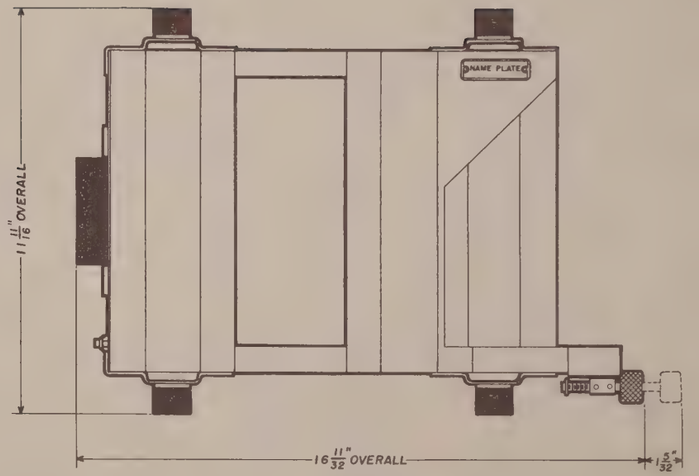


NAVY TYPE NO. CY-245/U OF TS-148/UP

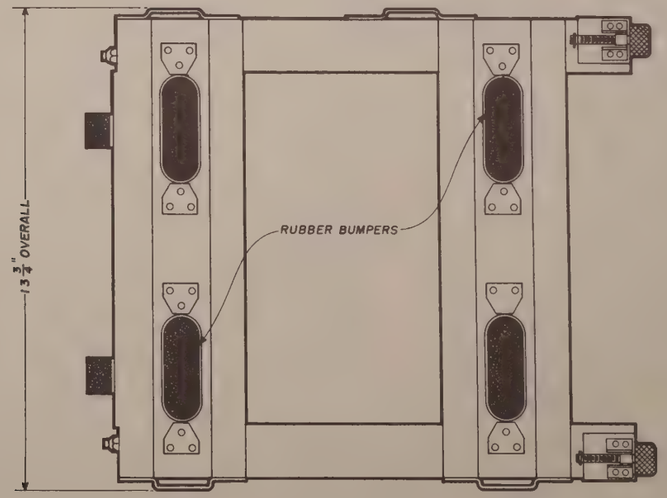
Figure 7-3. Auxiliary and Spare Parts Box, Outline Drawing (Dwg. 7613836)



REAR VIEW



SIDE VIEW



BOTTOM VIEW

NAVY TYPE NO. MT-325/U OF TS-148/UP

Figure 7-4. Carriage, Outline Drawing (Dwg. 7614111)

AN 16-35TS148-5

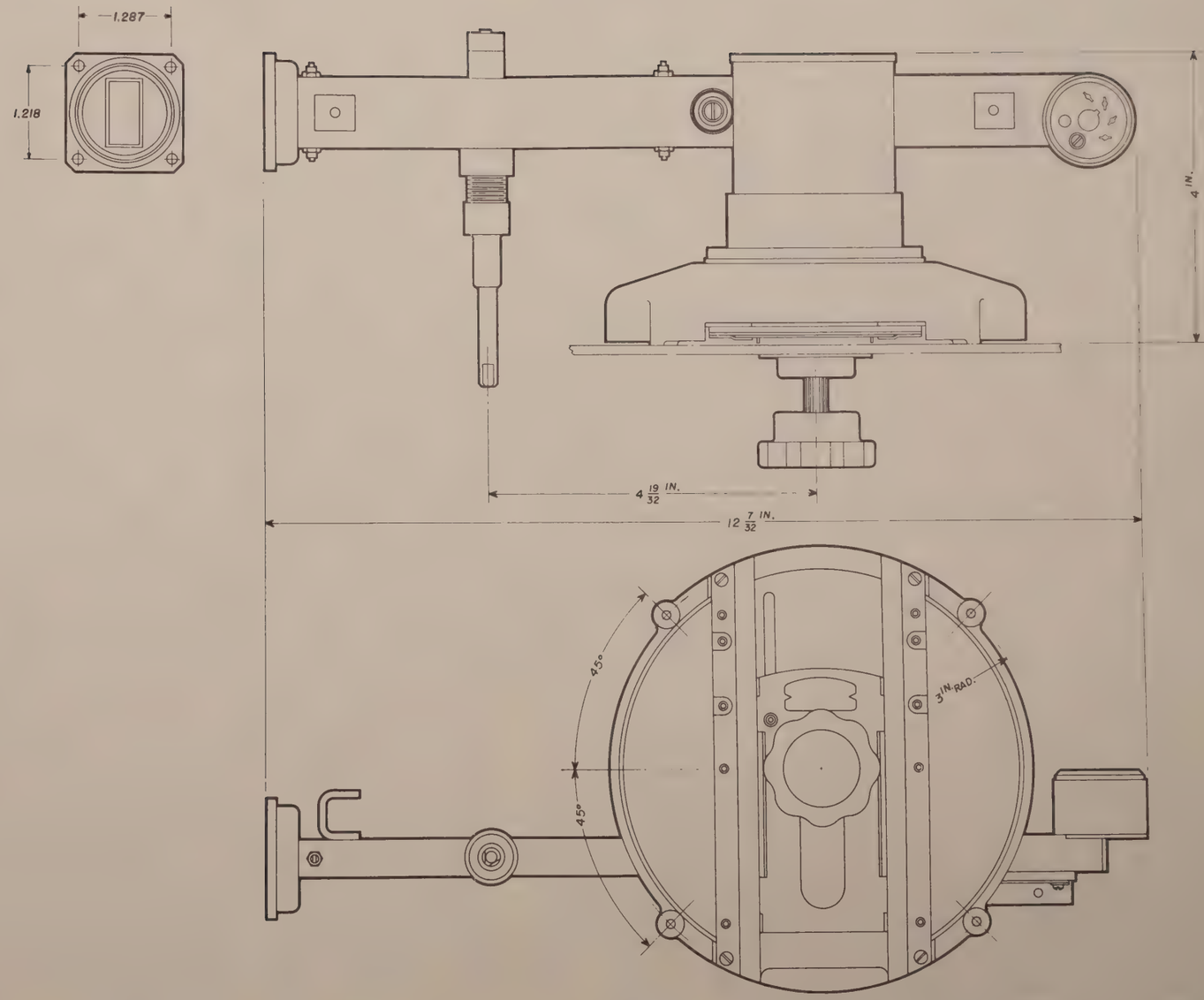
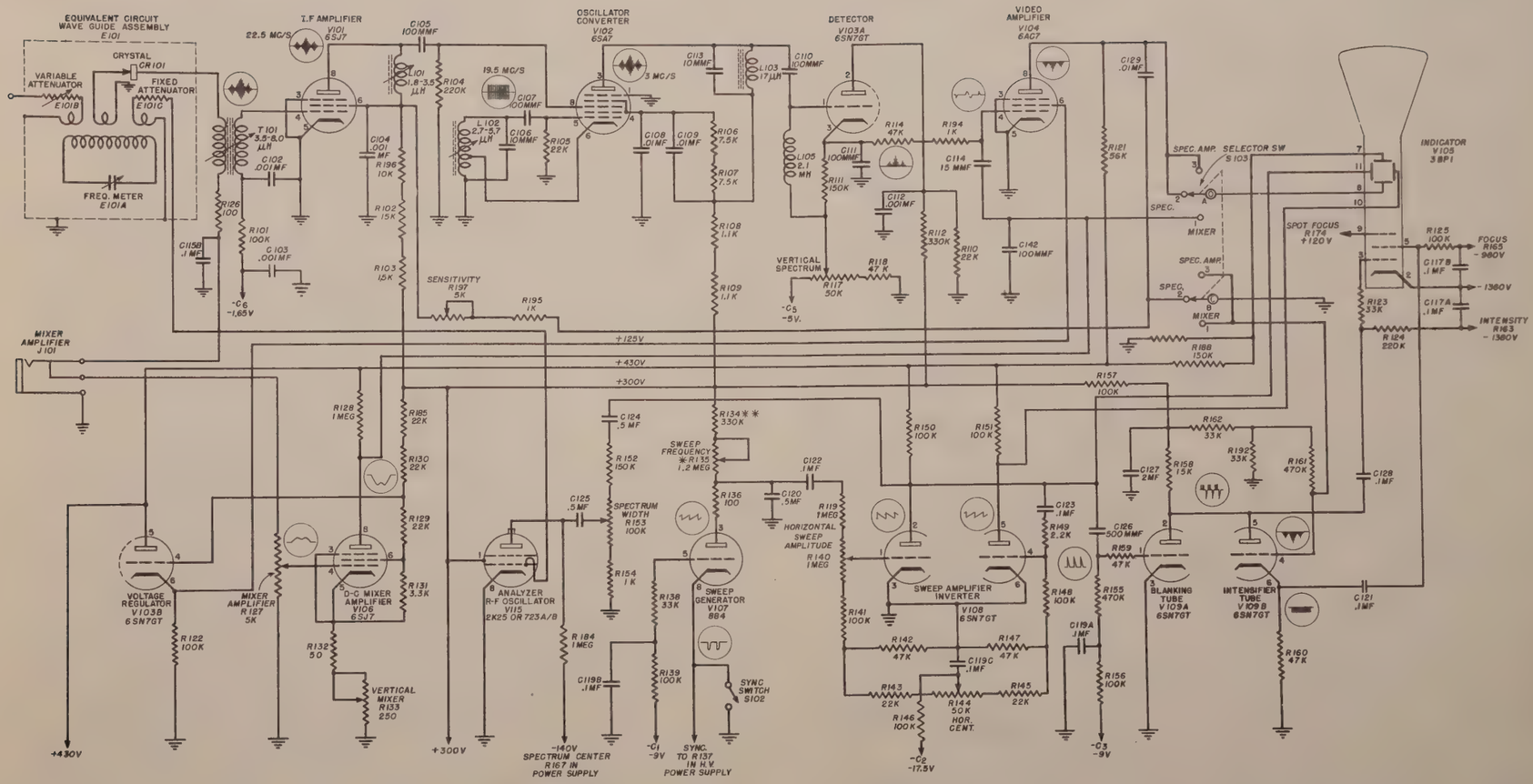


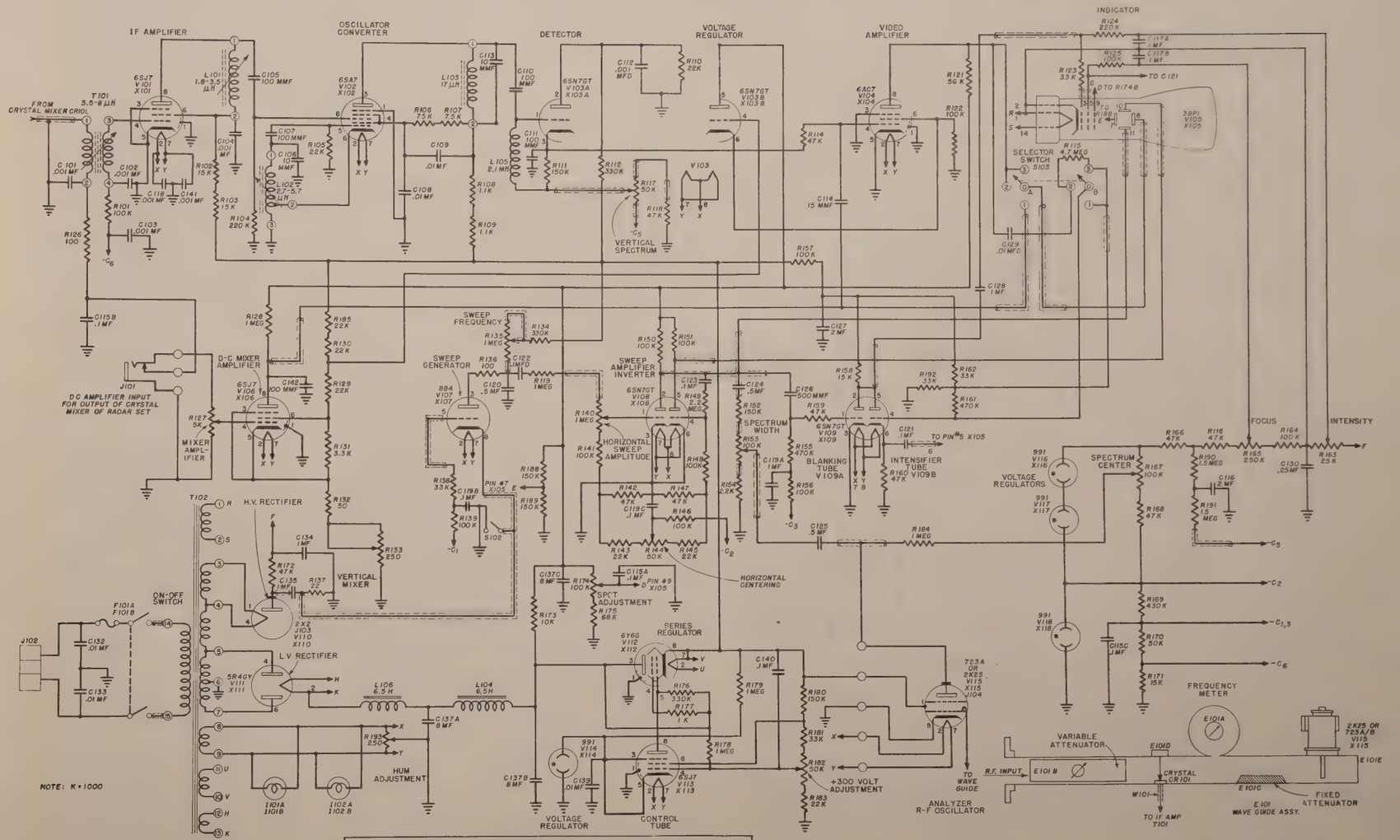
Figure 7-5. R-F Assembly, Outline Drawing (Dwg. 7714589)

AN 16-35TS148-5



NOTE: THIS FIGURE IS TO ILLUSTRATE THE TEXT IN SECTION III, THEORY OF OPERATION, AND IS NOT THE COMPLETE CIRCUIT.

Figure 7-6. Spectrum Analyzer, Simplified Schematic (Dwg. 7614504)

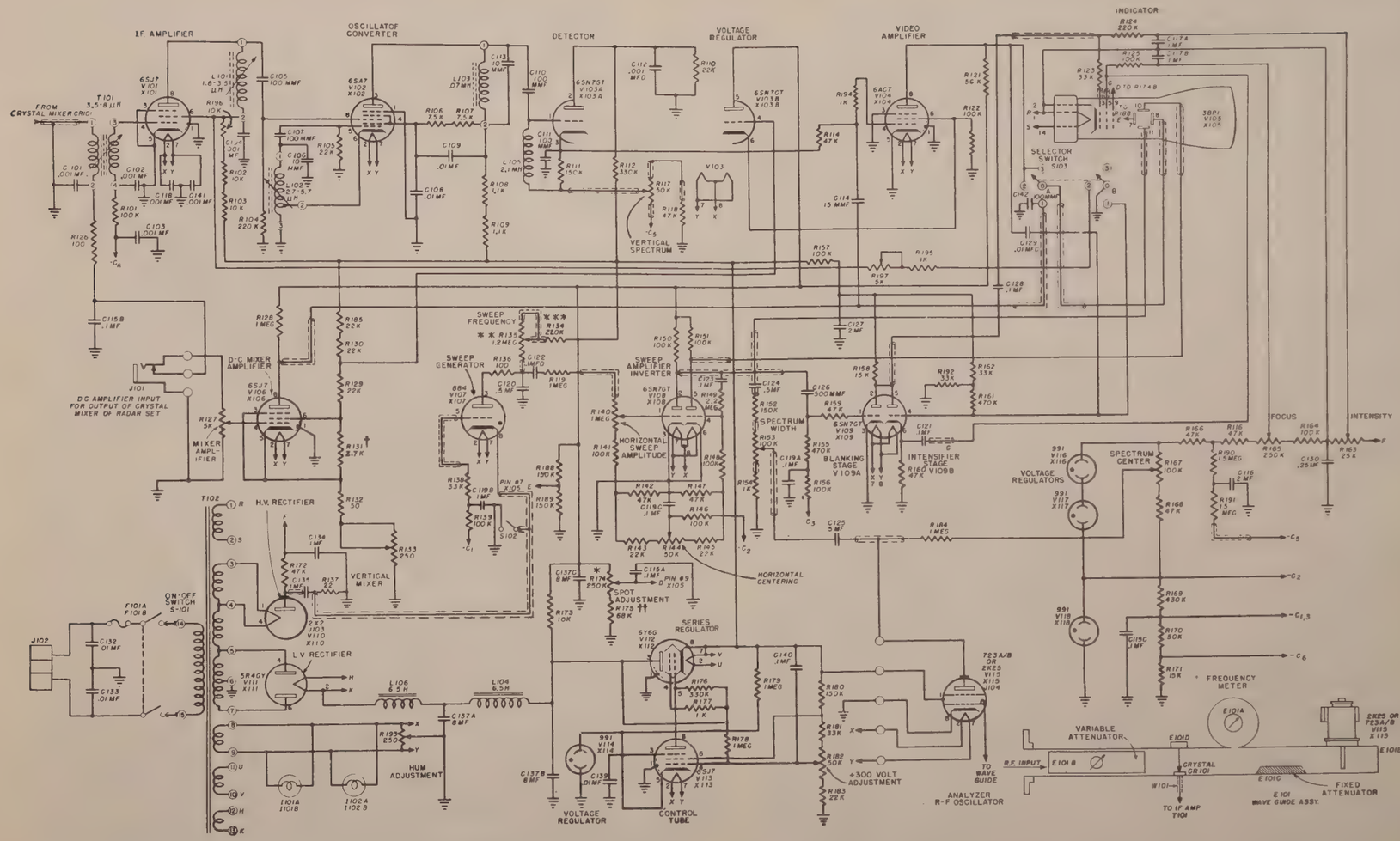


NOTE: THIS IS ORIGINAL CIRCUIT BEFORE MODIFICATIONS WERE MADE BEGINNING AT SER.NO. 25 SEE PAGE 5-2

Figure 7-7. Spectrum Analyzer, Complete Schematic (Dwg. 7613069-12) (Serial Nos. 1 to 25)

Fig. 7-7

AN 16-35TS148-5



NOTES

* R174 BECAME 250K AFTER SERIAL #165 (APPROX)

** R135 BECAME 1.2MEG AFTER SERIAL #496

*** R134 WAS 470K ON SERIAL NUMBERS 230 — 496 (APPROX) AND 330K ON ALL OTHER SETS. R134 CHANGED FROM 330K TO 220K IN SERIAL NUMBERS 1170 — 1688.

† R131 CHANGED FROM 3.3K TO 2.7K ±5% IN SERIAL NUMBERS 1060 — 1688.

†† R175 WAS OMITTED AT SERIAL NUMBER 165 AND R174 CONNECTED DIRECTLY TO GROUND.

LATEST REVISED CIRCUIT, FOR DESCRIPTION OF MODIFICATIONS SEE PAGE 5-2.

Figure 7-8. Spectrum Analyzer, Complete Schematic (Dwg. 7613069-14) (Serial Nos. 26 to 817 and 1001 to 1688)

Fig. 7-8

AN 16-35TS148-5

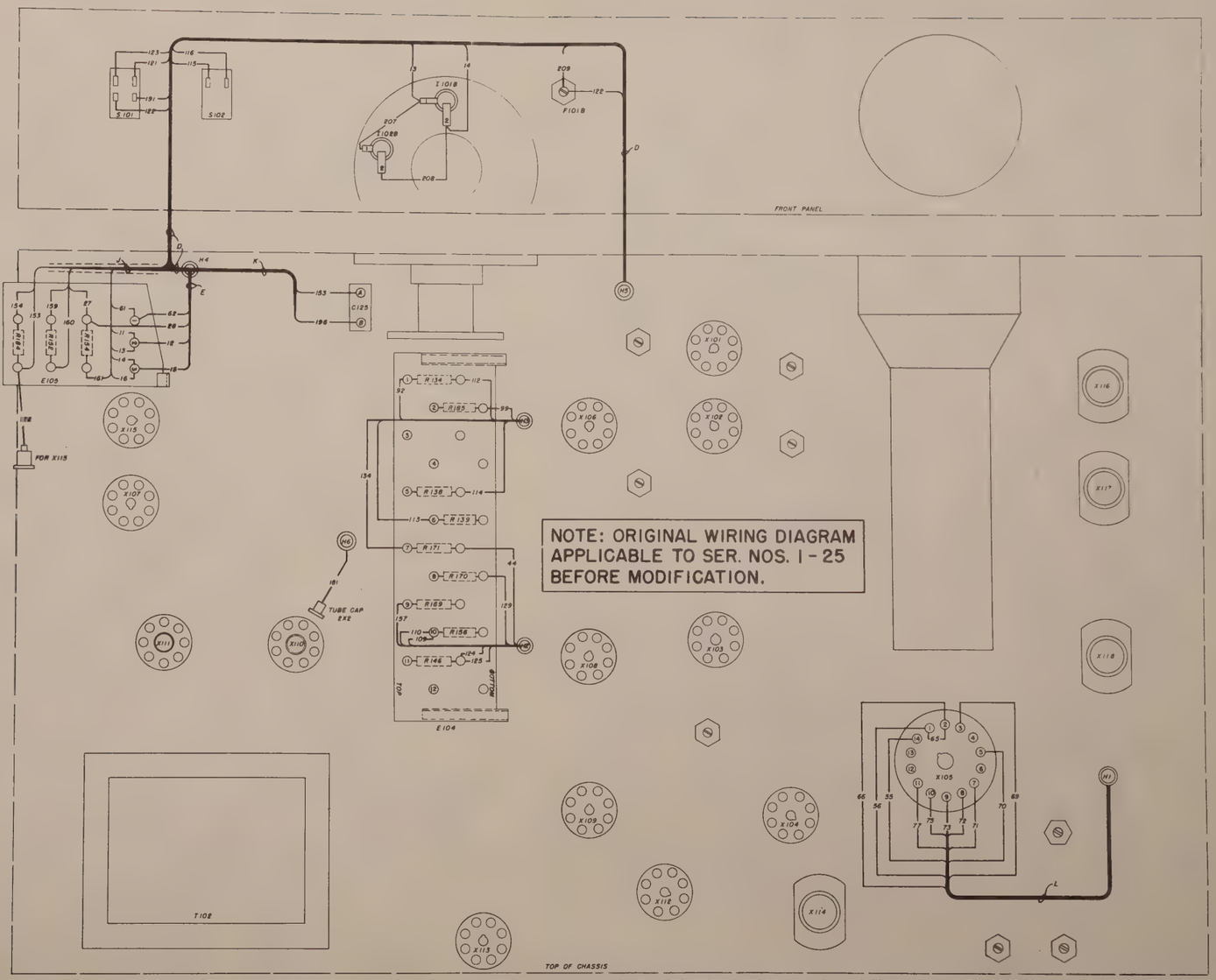
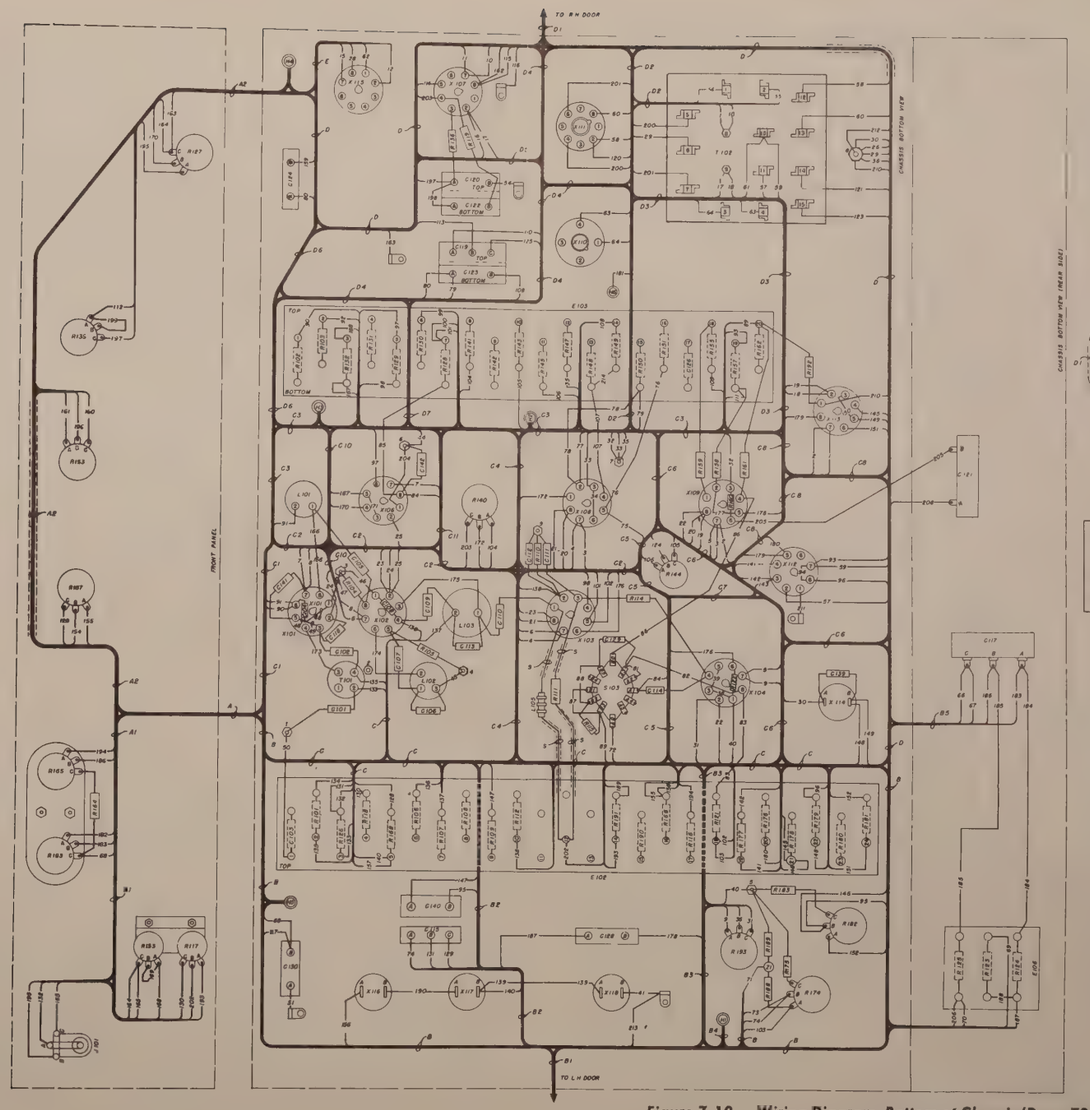
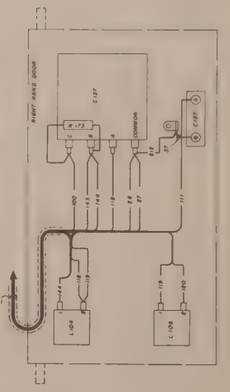


Figure 7-9. Wiring Diagram, Top of Chassis (Dwg. 7300859-0) Fig. 7-9
See Fig. 7-11 For Wiring Legend
(Serial Nos. 1-25)





NOTE: ORIGINAL WIRING DIAGRAM APPLICABLE TO SER. NOS. 1 ~ 25 BEFORE MODIFICATION.

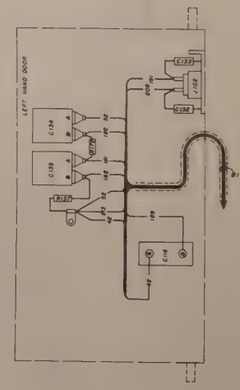


Figure 7-10. Wiring Diagram, Bottom of Chassis (Dwg. 7300859-0)
See Fig. 7-11 For Wiring Legend
(Serial Nos. 1-25)

Fig. 7-10

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
1	T102 #8	X113 #7	BK-BK	10-.010	D2,D3,C8
2	X113 #7	X109 #7	BK-BK	10-.010	C8-C6
3	X109 #7	X108 #7	BK-BK	10-.010	C6-C5-C2
4	X108 #7	X103 #7	BK-BK	10-.010	C2-C4
5	X109 #7	X104 #7	BK-BK	10-.010	C6
6	X103 #7	X102 #7	BK-BK	10-.010	C4-C2-C10
7	X106 #7	X101 #7	BK-BK	10-.010	C11-C2
8	X102 #7	X101 #7	BK-BK	10-.010	C10-C2
9	X104 #7	R193 A	BK-BK	10-.010	C6-C-B3
10	T102 #8	X107 #7	BK-BK	10-.010	D2-D
11	X107 #7	L.O.B. #2	BK-BK	10-.010	D-H4-D-J
12	LOB #2	X115 #2	BK-BK	10-.010	E-H4-E
13	LOB #2	I-101 B1	BK-BK	10-.010	J-D
14	I-101 B2	L.O.B. #3	BK-BK	10-.010	D-J
15	LOB #3	X115 #7	BK-BK	10-.010	E-H4-E
16	LOB #3	X107 #2	BK-BK	10-.010	J-D-H4-D-D5
17	X107 #2	T102 #8	BK-BK	10-.010	D5-D4-D2-D3
18	T102 #9	X113 #2	BK-BK	10-.010	D3
19	X113 #2	X109 #8	BK-BK	10-.010	D3-C3-C6
20	X109 #8	X108 #8	BK-BK	10-.010	C6-C5-C2
21	X108 #8	X103 #8	BK-BK	10-.010	C2-C4
22	X109 #8	X104 #2	BK-BK	10-.010	C6-C
23	X103 #8	X102 #2	BK-BK	10-.010	C4-C2
24	X102 #2	X101 #2	BK-BK	10-.010	C2-C10
25	X102 #2	X106 #2	BK-BK	10-.010	C2
26	GND #8	C137- COMMON	W	26-.010	D1-D
27	C137 COMMON	LOB (R154)	W	10-.010	D1-D-H4-D-J
28	LOB (R154)	X115 #8	W	10-.010	E-H4-E
29	GND #8	T102 #8	W	10-.010	D-D2
30	GND #8	X114A	W	10-.010	D-C6
31	R193 C	X104 #2	BK-BK	10-.010	B3-C
32	X109 #3	GND #7	W	7-.010	C3
33	GND #7	X108 #3	W	7-.010	C3
34	X108 #3	X108 #6	JUMPER	#18 TIN	-
35	GND #7	W8 #128(R147)	W	7-.010	C3
36	R193B	GND #8	W	10-.010	B3-C-D
37	C127 B	GND-LUG-BASE	JUMPER	#18 TIN	-
38	X104 #1	X104 #3	JUMPER	#18 TIN	-
39	X104 #3	X104 #5	JUMPER	#18 TIN	-
40	X104 #1	GND #5	W	7-.010	C-B3
41	X118 B	GND LUG	JUMPER	#18 TIN	-
42	C116A	GND LUG-BASE	W	7-.010	B1
43					
44	SB #78 (R171)	GND #6	W	7-.010	H2-C
45	L102 #3	GND #4	JUMPER	#18 TIN	-
46	X102 #1	GND #3	JUMPER	#18 TIN	-
47	X101 #1	GND #3	JUMPER	#14 TIN	-
48	X101 #5	X101 #1	JUMPER	#14 TIN	-
49	X101 #3	JUMPER #48	JUMPER	#18 TIN	-
50	LB#1T(C103)	GND #1	JUMP-S	#18 TIN	DIRECT
51	C130A	GND LUG-BASE	JUMPER	#18 TIN	-
52	C-134A	GND LUG-BASE	W	7-.010	B1
53					
54	C120 B	GND LUG-BASE	JUMPER	#18 TIN	
55	X105 #4	T102 #2	GN-GN	7-.010	L-H1-B4-B3-C-C6-C8-D3-D2
56	X105 #1	T102 #1	R-R	7-.010	SAME AS #55
57	T102 #11	X112 #2	BN-BN	7-.010	D3-C8-D
58	T102 #12	X111 #2	R-GN	7-.010	D-D2
59	T102 #10	X112 #7	BN-BN	7-.010	D3-C8-D
60	T102 #13	X111 #6	OR-OR	7-.010	D2
61	T102 #10	LOB #1	BN-BN	7-.010	D3-D4,D5,D-H4-D-J
62	LOB #1	X115 #1	BN-BN	7-.010	E-H4-E
63	T102 #4	X110 #4	BL-BN	7-.010	D3-D2
64	T102 #3	X110 #1	BL-BN	7-.010	D3
65	X105 #1	X105 #2	R-R	7-.010	DIRECT
66	X105 #2	C117-C	R-R	7-.010	L-H1-B4-B-B5
67	C117C	C130 B	R-R	7-.010	B5-B
68	C130 B	R163-C	R-R	7-.010	B-A-A1
69	X105 #3	HVB (R123)	BK-BNX	7-.010	L-H1-B4-B
70	X105 #5	HVB (R125)	R-ORX	7-.010	L-H1-B4-B

WIRES MARKED WITH X ARE SHIELDED WITH TINNED COPPER BRAID

NOTE-ORIGINAL WIRING LEGEND APPICABLE TO SER. NOS. 1-25 BEFORE MODIFICATION.

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WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
71	X105 #7	Z-1	R-GN	7-.010	L-H1-B4-B
72	X105 #8	S103-0A	OR-GNX	7-.010	L-H1-B4-B-B3-C
73	X105 #9	R174 B	OR-BL	7-.010	L-H1-B4-B
74	R174-B	C115A	OR-BL	7-.010	B-B2
75	X105 #10	X108 #5	OR-BKX	7-.010	L-H1-B4-B3-C5
76	X108 #5	W8#16 B(R151)	JUMP-S	#18 TIN	-
77	X105 #11	X108 #2	OR-BNX	7-.010	L-H1-B4-B3-C5-C
78	X108 #2	W8 #158 (R150)	JUMP-S	#18 TIN	-
79	W8#15B(R150)	C123A	OR-BNX	7-.010	C3-D7-D4
80	C123A	C124A	OR-BNX	7-.010	D4-D6-D
81	S102 A2	S102 A3	JUMPER	#18 TIN	-
82	S103 A3	X104 #8	JUMP-S	#18 TIN	-
83	X104 #9	LB #1B8 (R121)	JUMP-S	#18 TIN	-
84	S103 A1	X106 #8	GN-BLX	7-.010	C5-C2-C11
85	X106 #8	W8#78(R128)	JUMP-S	#18 TIN	-
86	S103-B0	X109 #4	JUMP-S	#18 TIN	-
87	S103-B3	S103 B1	JUMP-S	#18 TIN	-
88	S103 B2	S103 B5	JUMP-S	#18 TIN	-
89	S103 B3	W8 #20T (R162)	BL-BKX	7-.010	C-C6-C8-C3
90	W8 # 1T(R102)	X101 #6	BL-BN	7-.010	C3-C1
91	X101 #6	L101 #2	BL-BN	7-.010	C1-C3
92	W8 #2T(R103)	SB#1B(R134)	BN-BN	7-.010	C3-H3
93	W8 #19T (R157)	X112 #7	BN-BN	7-.010	C3-C8-D
94	X112 #7	X112 #8	JUMPER	#18 TIN	-
95	R182B	C140 B	R-GN	7-.010	B-B2
96	X112 #8	LB #22B(R179)	BN-BN	7-.010	D-C
97	W8#5T(R129)	X106 #6	R-OR	7-.010	C3
98	W8#5B (R129)	X103 #4	BK-BN	7-.010	C3-C4-C2
99	W8#6T(R130)	SB #2B (R185)	R-GN	7-.010	C3-H3
100	W8#7T(R128)	C137-D	R-BK	7-.010	C3-D7-D4-D1
101	W8#7T(R128)	X103#5	R-BK	7-.010	C3-C4-C2
102	X103#5	LB#1BT(R121)	R-BK	7-.010	C2-C5-C
103	LB#1BT(R121)	R174A	R-BK	7-.010	B3-B
104	W8#8B(R141)	R140 A	R-BLX	7-.010	C3-C2
105	W8#10B(R143)	R144C	BL-BL	7-.010	C3-C6
106	W8#11B(R145)	R144A	GN-BN	7-.010	C3-C5
107	X109#4	W8 13B(R148)	JUMP-S	#18 TIN	DIRECT
108	W8#14T(R149)	C123B	GN-BLX	7-.010	C3-D7-D4
109	W8#18B(R155)	SB#10T(R156)	OR-GN	7-.010	C3-H2
110	SB#10T(R156)	C119 A	OR-GN	7-.010	H2-C3-D7-D4
111	W8#19B(R157)	C127A	R-GN	7-.010	C3-D7-D4-D1
112	SB#1T(R134)	R135A	OR-BLX	7-.010	H3-C3-D6-D-A2
113	SB#6T(R139)	C119B	R-R	7-.010	-C3-D6-D
114	SB#5B(R138)	X 107 #5	GN-GNX	7-.010	H3-C3-D6-D
115	X107#8	S102	OR-BKX	7-.010	D-H4-D
116	GND LUG X107	S102	R-BLX	7-.010	D-H4-D
117					
118	C137A	L104 #2	OR-OR	7-.010	D1
119	L104 #2	L106 #1	OR-OR	7-.010	DIRECT
120	L106 #2	X111 #2	R-GN	7-.010	D1-D-D2
121	T102 #14	S101	OR-BN	7-.010	D-B-H5-D
122	F101 B	S101	GN-BL	7-.010	D
123	S101	T102 #15	R-OR	7-.010	D-B-H5-D
124	SB#11B(R146)	R144 B	GN-BK	7-.010	H2-C3-C6-C5
125	SB#11B(R146)	C119C	GN-BK	7-.010	H2-C3-D7-D4
126					
127					
128	LB#5B(R168)	R167C	R-GN	7-.010	C-B-A-A2
129	SB#8B(R170)	C115C	R-BK	7-.010	H2-C3-C4-C-B2
130	LB#4B(R118)	R117C	BL-BNX	7-.010	C-B-A-A1
131	LB#3B(R126)	C115B	R-BL	7-.010	C-B2
132	LB#3B(R126)	J101A	R-BL	7-.010	C-B-A-A1
133	LB#3T(R126)	T-101 #2	GN-GN	7-.010	C
134	LB#2B(R101)	SB#7T(R171)	BK-R	7-.010	C-C1-C3-H3
135	LB#2T(R101)	T101 #4	GN-BN	7-.010	C
136	LB#6B(R106)	X102 #4	OR-BK	7-.010	C
137	LB#7B(R107)	L-103 #2	OR-OR	7-.010	C
138	LB#10T(R112)	X103 #2	R-R	7-.010	C-C4
139	X118A	X117B	JUMP-S	#18 TIN	DIRECT
140	LB#3T(R16B)	X117B	R-R	7-.010	C-B2

JUMPER WIRES MARKED WITH S ARE COVERED WITH 18 FIBERGLASS SLEEVING

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WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
141	LB#19T(R177)	X112#4	GN-GN	7-010	C-C6-C8
142	LB#19B(R177)	X112#3	OR-BK	7-010	C-C6
143	X112 #3	C137 B	OR-BK	7-.010	C6-C8-C3-D2-D4-D1
144	C137 B	L104	OR-BK	7-.010	D1
145	LB#21T(R178)	X113 #4	R-GN	7-.010	C-D
146	LB#21T(R178)	R182 B	R-GN	7-.010	C-B
147	LB#9B(R109)	C140A	BN BN	7-.010	C-B2
148	LB#22T(R179)	X114 B	R-BK	7-.010	C
149	X114B	X113 #5	R-BK	7-.010	D
150	X113 #5	X113 #3	JUMPER	#18 TIN	-
151	LB#24T(R181)	X113 #6	OR-OR	7-.010	C-D
152	LB#24B(R181)	R182A	BL-BL	7-.010	C-B
153	LOB (R184)	C125A	GN-BN	7-.010	J-D-K
154	LOB (R184)	R167-B	GN-BL	7-.010	J-D-H4-A2
155	R187 A	LB#16B(R166)	BK-BN	7-.010	C-B-A1-A2
156	LB#16B(R166)	X116 A	BK-BN	7-.010	C-B3-B
157	LB5T(R16B)	SB#9T(R169)	R-R	7 -.010	C-C4-H2
158	LOB (R184)	723A CAP	GN-BN	7-.010	DIRECT
159	LOB (R162L)	C124 B	GN-BKX	7-.010	J-D-H4-D
160	LOB (R162)	R153C	BL-BNX	7-.010	J-D-H4-A2
161	LOB (R154)	R163A	R-RX	7-.010	J-D-H4-A2
162	X107 #8	C135 B	OR-BKX	7-.010	D-D6-C3-C1-B-B1
163	C119 GND LUG BOT	R127-C	W	7-.010	D-A2
164	R127C	R133C	W	7-.010	A2-A1
165	R133C	GND ON J101C-(GND)	W	7-.010	A1
166	L101 #1	X101 #8	JUMP-S	#18 TIN	-
167	W8#3B(R132)	X106 #5	OR-GN	7-.010	C3-C10
168	W8#3T(R132)	R133A	BL-BL	7-.010	C3-C1-A-A1
169	R133B	R133A	JUMPER	#18 TIN	-
170	X106#4	R127B	BL-BN	7-010	C10-C3-D6-D-A2
171	X106#5	X106#3	JUMPER	#18 TIN	-
172	R140B	X108#1	GN-GNX	7-.010	C2-C4
173	X101#4	T101#3	JUMPER	#18 TIN	DIRECT
174	X102#6	L102#2	JUMP-S	#18 TIN	DIRECT
175	X102 #3	L103 #1	JUMP-S	#18 TIN	DIRECT
176	X103 #6	X104 #6	BK-BL	7-.010	C5
177	X109 #2	X109 #5	JUMPER	#18 TIN	-
178	X109 #5	C128	BL-BNX	7-.010	C8-C6-C-B3
179	X113 #8	X112 #5	GN-BN	7-.010	C8
180	X112 #5	LB 2DT(R176)	GN-BN	7-.010	C8-C6-C
181	C135A	CAP 2X2	BK-BL	7-.010	B1-B-B3-C-C6-C3-D2-H6
182	C134 B	R163A	R-GN	7-.010	B1-B-A-A1
183	R163B	C117A	OR-BL	7-.010	A1-A-B-B5
184	C117A	HVB (R124)	JUMP-S	#18 TIN	DIRECT
185	C117B	HVB#4(R125)	JUMP-S	#18 TIN	DIRECT
186	C117B	R165B	OR-OR	7-.010	B-A-A1
187	HVB(R124)	C128	R-BLX	7-.010	B-B2
188	HVB	HVB	JUMPER	#18 TIN	-
189	C116B	LB#14B(R191)	BK-BN	7-.010	B1-B-B3-C
190	X117A	X116B	JUMP-S		-
191	S101	J102	BN-BN	7-.010	D-H5-B B1
192					
193	R117A	LB#14T(R191)	R-ORX	7-.010	A1-A-B-C
194	LB#17B(R116)	R165A	GN-BK	7-.010	C-B-A-A1
195	J101B	R127A	R-GN	7-.010	A1-A2
196	C125B	R153B	OR-BKX	7-.010	K-H4-A2
197	R135C	C120A	OR-BNX	7-.010	A2-D
198	C120A	C122	JUMPER	#18 TIN	-
199	R135B	R135A	JUMPER	#18 TIN	-
200	T102 #5	X111 #4	GN-BNX	7-.010	D2
201	T102 #7	X111 #6	OR-GNX	7-.010	D2
202	LB-12T(BLANK)	R117B	OR-BNX	7-.010	C-B-A-A1
203	X107 #4	R140C	BK-BNX	7-.010	D-D5-D4-D7-C3-C11-C2
204	X106 #1	GND #6	JUMP-S	#18 TIN	DIRECT
205	X109 #6	C121B	JUMP-S	#18 TIN	DIRECT
206	C121A	HVB. (R125)	R-ORX	7-.010	D-B
207	I-101B1	I-102B1	BK-BK	7-.010	DIRECT
208	I-101B2	I-102B2	BK-BK	7-.010	DIRECT
209	F101B	J102	BK-BL	7-.010	D-H5-B-B1
210	X113 #1	GND #8	W	7-.010	D
211	X112 #1	MTG BASE LUG	JUMPER	#18 TIN	DIRECT
212	GND-RH-DOOR	C137 COMMON	W	10-.010	DIRECT
213	GND-LH DOOR	118GND LUG	W	10-.010	B1-B

CABLES J-B1-D-D1-A2 SHOWN AS ═══ ARE COVERED WITH VERSIFLEX TUBING

Figure 7-11. Wiring Legend (Serial Nos. 1-25) (Dwg. 7300859-0)

AN 16-35TS148-5

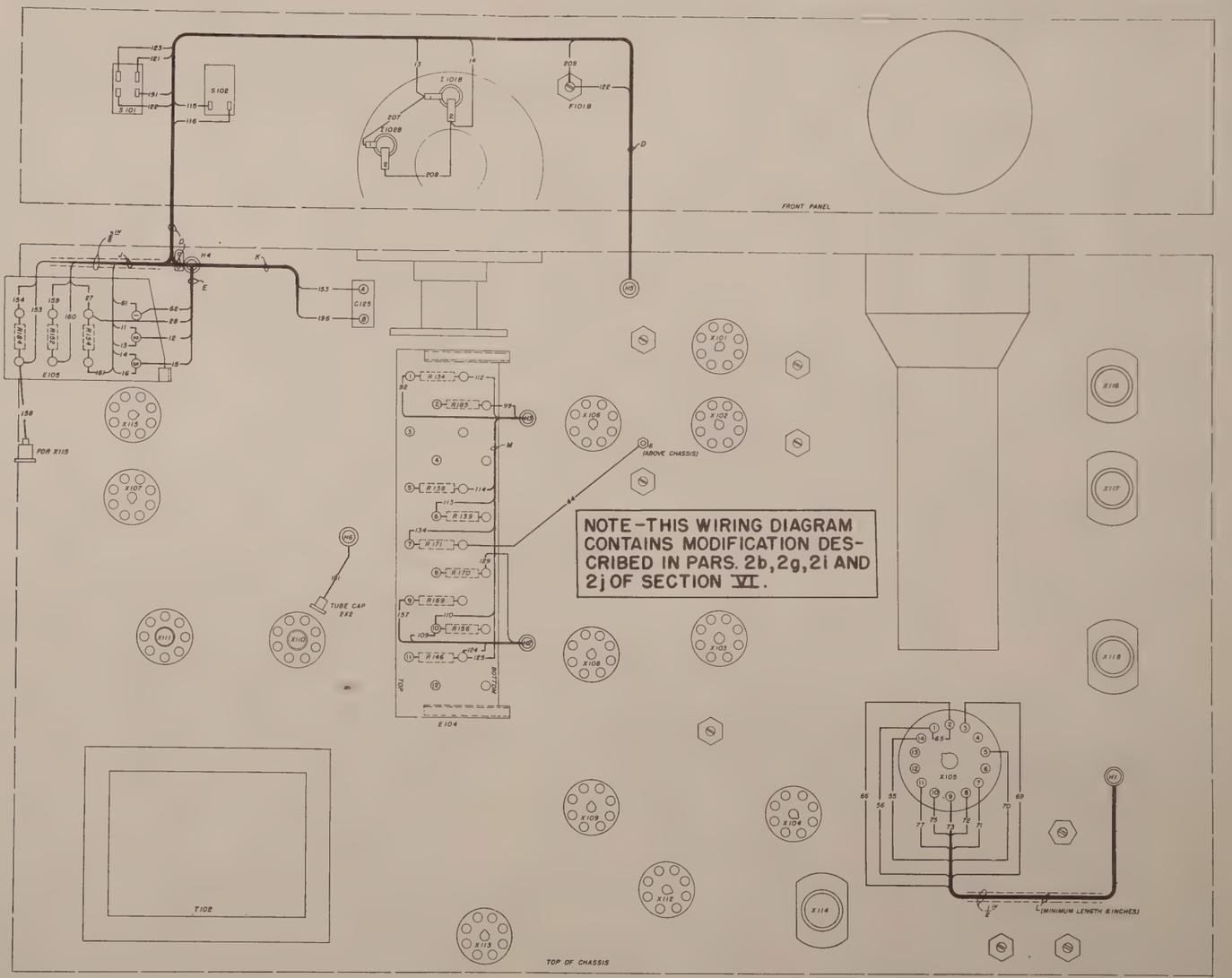


Figure 7-12. Wiring Diagram, Top of Chassis (Dwg. 7300859-9) See Fig. 7-14 For Wiring Legend (Serial Nos. 26-174, and 176, 177, 179, 180, 181, 182, 185, 187, 192, 193, 195, 196, 197, 203, 208, 213, 218, 232, 238, 242, 262 and 339.)

Fig. 7-12

AN 16-35TS148-5

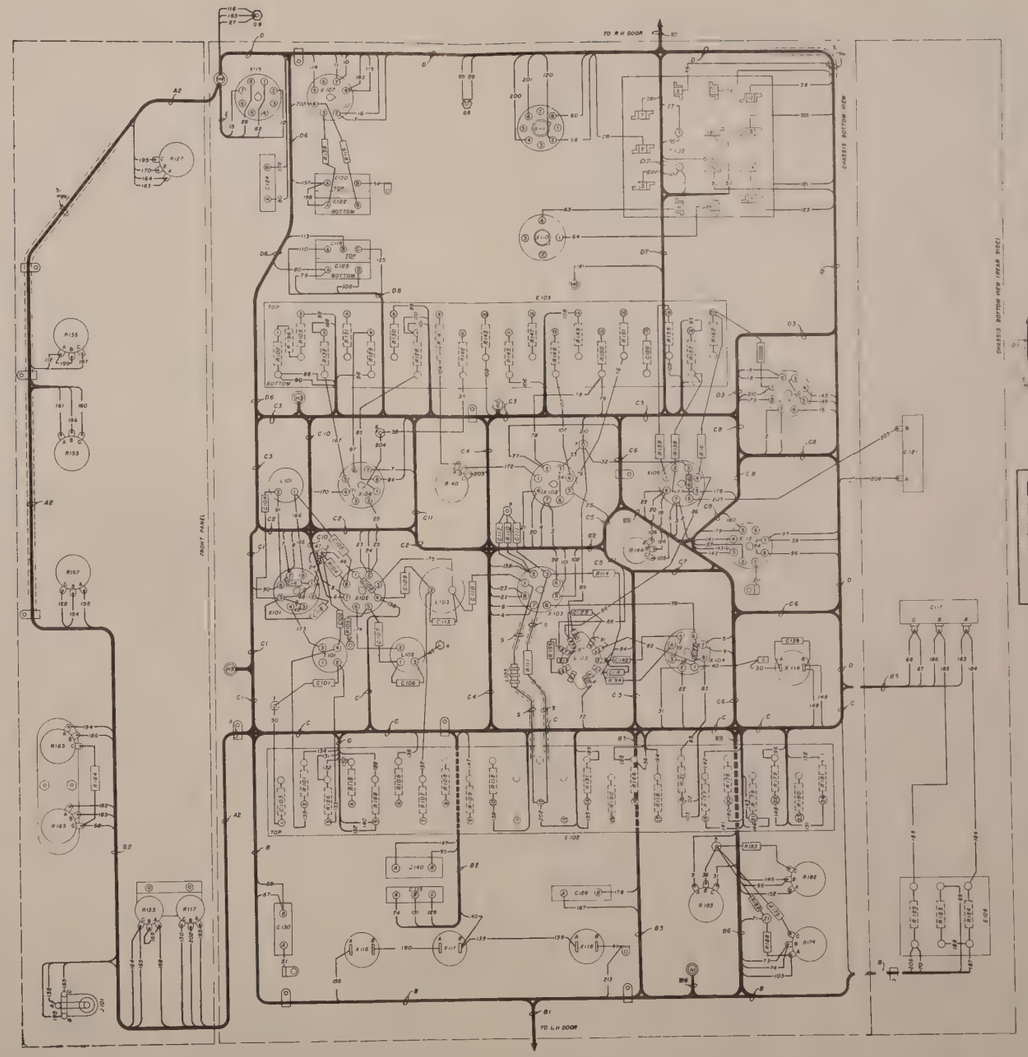

TO R H DOOR
TO L H DOOR
FRONT PANEL
CHASSIS BOTTOM VIEW
CHASSIS BOTTOM VIEW (REAR SIDE)
RIGHT HAND DOOR
LEFT HAND DOOR
NOTE-THIS WIRING DIAGRAM CONTAINS MODIFICATION DESCRIBED IN PARS. 2b, 2g, 2i AND 2j OF SECTION VI.

Figure 7-13. Wiring Diagram, Bottom of Chassis (Dwg. 7300859-9) See Fig. 7-14 For Wiring Legend (Serial Nos. 26-174, and 176, 177, 179, 180, 181, 182, 185, 187, 192, 193, 195, 196, 197, 203, 208, 213, 218, 232, 238, 242, 262 and 339.)

Fig. 7-13

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
1	T102 #8	X113 #7	BK-BK	10-.010	D7,C3,C8
2	X113 #7	X109 #7	BK-BK	10-.010	C8-C6
3	X109 #7	X108 #7	BK-BK	10-.010	C6-C5-C2
4	X108 #7	X103 #7	BK-BK	10-.010	C2-C4
5	X109 #7	X104 #7	BK-BK	10-.010	C6
6	X103 #7	X102 #7	BK-BK	10-.010	C4-C2-C10
7	X106 #7	X101 #7	BK-BK	10-.010	C11-C2
8	X102 #7	X101 #7	BK-BK	10-.010	C10-C2
9	X104 #7	R193 A	BK-BK	10-.010	C6---86
10	T102 #8	X107 #7	BK-BK	10-.010	D7---D
11	X107 #7	L.O.8. #2	BK-BK	10-.010	D-H4-D-J
12	L08 #2	X115 #2	BK-BK	10-.010	E-H4-E
13	L08 #2	I-101 B1 SIDE	BK-BK	7-.010	J-D
14	I-101 B2	L.O.8. #3	BK-BK	7-.010	D-J
15	L08 #3	X115 #7	BK-BK	10-.010	E-H4-E
16	L08 #3	X107 #2	BK-BK	10-.010	J-D-H4-D--
17	X107 #2	T102 #8	BK-BK	10-.010	D----D7--
18	T102 #8	X113 #2	BK-BK	10-.010	D7-C3-D8
19	X113 #2	X109 #8	BK-BK	10-.010	D3-C3-C6
20	X109 #8	X108 #8	BK-BK	10-.010	C6-C5-C2
21	X108 #6	X103 #8	BK-BK	10-.010	C2-C4
22	X109 #8	X104 #2	BK-BK	10-.010	C6-C
23	X103 #8	X102 #2	BK-BK	10-.010	C4-C2
24	X102 #2	X101 #2	BK-BK	10-.010	C2-C10
25	X102 #2	X106 #2	BK-BK	10-.010	C2
26	GND #8	C137- COMMON	W	26-.010	D -D1
27	GND #9	L08 (R154)	W	10-.010	D-H4
28	L08 (R154)	X115 #8	W	10-.010	E-H4-E
29	GND #8	T102 #6	W	10-.010	D-
30	GND X114 LUG	X114 A	JUMPER	#18 TIN	-
31	R193 C	X104 #2	BK-BK	10-.010	B6-C
32	X109 #3	GND #7	JUMPER	#18 TIN	-
33	GND #7	X108 #3	JUMPER	#18 TIN	-
34	X108 #3	X108 #6	JUMPER	#18 TIN	-
35	GND #6	MB # 9B(R142)	JUMPER-S	#18 TIN	-
36	R193B	GND #6	JUMPER	#18 TIN	-
37	C127 B	GND-LUG-BASE	JUMPER	#18 TIN	-
38	X104 #1	X104 #3	JUMPER	#18 TIN	-
39	X104 #3	X104 #5	JUMPER	#18 TIN	-
40	X104 #1	GND LUG BASE X-114	JUMPER-S	#18 TIN	-
41	X118 B	GND LUG	JUMPER	#18 TIN	-
42	C116A	GND LUG-BASE	W	7-.010	
43					
44	SB #7B (R171)	GND #6 ABOVE CHASSIS	JUMPER-S	#18 TIN	
45	L102 #3	GND #4	JUMPER	#18 TIN	-
46	X102 #1	GND #3	JUMPER	#18 TIN	-
47	X101 #1	GND #3	JUMPER	#14 TIN	-
48	X101 #5	X101 #1	JUMPER	#14 TIN	-
49	X101 #3	X101 #5	JUMPER	#18 TIN	-
50	LB#1T(C103)	GND #1	JUMP-S	#18 TIN	DIRECT
51	C130A	GND LUG-BASE	JUMPER	#18 TIN	-
52	C-134A	GND LUG-BASE	W	7-.010	B1
53					
54	C120 B	GND LUG-BASE	JUMPER	#18 TIN	
55	X106 #14	T102 #2	GN-GN	7-.010	L-H1-B4-B-B3-C-D
56	X105 #1	T102 #1	R-R	7-.010	SAME AS #55
57	T102 #11	X112 #2	BN-BN	7-.010	D7-C3-C8
58	T102 #12	X111 #2	R-GN	7-.010	D-
59	T102 #10	X112 #7	BN-BN	7-.010	D
60	T102 #13	X111 #8	OR-OR	7-.010	D
61	T102 #10	L08 #1	BN-BN	7-.010	-D7,--,D-H4-D-J
62	L08 #1	X115 #1	BN-BN	7-.010	E-H4-E
63	T102 #4	X110 #4	BL-BN	7-.010	DIRECT
64	T102 #3	X110 #1	BL-BN	7-.010	DIRECT
65	X105 #1	X105 #2	R-R	7-.010	DIRECT
66	X105 #2	C117-C	R-R	7-.010	L-H1-B4-B-B3-C-B5
67	C117C	C130 B	R-R	7-.010	B5-C-B3-B
68	C130 B	R163-C	R-R	7-.010	B-A-A2
69	X105 #3	HVB (R123)	BK-BNX	7-.010	L-H1-B4-B
70	X105 #5	HVB (R125)	R-ORX	7-.010	L-H1-B4-B

WIRES MARKED WITH X ARE SHIELDED WITH TINNED COPPER BRAID ITEM NO.27 DWG.7714824

NOTE: THIS WIRING LEGEND CONTAINS THE MODIFICATIONS DESCRIBED IN PARS. 2b, 2g, 2i, 82 j OF SECTION VI.

AN 16-35TS148-5

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
71	X105 #7	Z-1	R-GN	7-.010	L-H1-B4-B-B6
72	X105 #8	S103-0A	OR-GNX	7-.010	L-H1-B4-B-B3-C
73	X105 #9	R174 B	OR-BL	7-.010	L-H1-B4-B6
74	R174-B	C115A	OR-BL	7-.010	B6-C-B2
75	X105 #10	X108 #5	OR-BNX	7-.010	L-H1-B4-B3-C5
76	X108 #5	MB#1B B(R151)	JUMP-S	#18 TIN	-
77	X105 #11	X108 #2	OR-BNX	7-.010	L-H1-B4-B3-C5-C6
78	X108 #2	MB #15B (R150)	JUMP-S	#18 TIN	-
79	MB#15B(R150)	C123A	OR-BNX	7-.010	C3-C8
80	C123A	C124A	OR-BNX	7-.010	--D6-D
81	S103 A2	S103 A3	JUMPER	#18 TIN	-
82	S103 A2	X104 #8	JUMP-S	#18 TIN	-
83	X104 #8	L8 #19B (R121)	JUMP-S	#18 TIN	-
84	S103 A1	X106 #8	GN-BLX	7-.010	C5-C2-C11-C3
85	X106 #8	MB#7B(R128)	JUMP-S	#18 TIN	-
86	S103-B5	X109 #4	JUMP-S	#18 TIN	-
87	S103-B1	S103 B5	JUMP-S	#18 TIN	-
88	S103 B4	MB#1B (R102)	R-BL	7-.010	C5-C6-C3
89	S103 B0	GND #7	JUMP-S	#18 TIN	DIRECT
90	MB # 1B(R102)	X101 #6	BL-BN	7-.010	C3-C1
91	X101 #6	L101 #2	JUMP-S	#18 TIN	-
92	MB #2T(R103)	SB#1B(R134)	BN-BN	7-.010	C3-H3
93	MB #19T (R157)	X112 #7	BN-BN	7-.010	C3-C8-D
94	X112 #7	X112 #8	JUMPER	#18 TIN	-
95	R182B	C140 B	R-GN	7-.010	B6-C-B2
96	X112 #8	LB #22B(R179)	BN-BN	7-.010	D-C
97	MB#5T(R129)	X106 #6	JUMP-S	#18 TIN	-
98	MB#5B (R129)	X103 #4	BK-BN	7-.010	C3-C4-C2
99	MB#6T(R130)	SB #2B (R185)	R-GN	7-.010	C3-H3
100	MB#7T(R128)	C137-C	R-BK	7-.010	C3-D7-D1
101	MB#7T(R128)	X103#5	R-BK	7-.010	C3-C4-C2
102	X103#5	LB#18T(R121)	R-BK	7-.010	C2-C6-C
103	LB#18T(R121)	R174A	R-BK	7-.010	C-B6
104	MB#8B(R141)	R140 A	JUMP-S	#18 TIN	-
105	MB#10B(R143)	R144C	BL-BL	7-.010	C3-C8
106	MB#11B(R145)	R144A	GN-BN	7-.010	C3-C6
107	X108#4	MB13B(R148)	JUMP-S	#18 TIN	DIRECT
108	MB#14T(R149)	C123B	GN-BLX	7-.010	C3-C8
109	MB#19B(R155)	SB#10T(R156)	OR-GN	7-.010	C3-H2
110	SB#10T(R156)	C119 A	OR-GN	7-.010	M-H3-C3-D8
111	MB#19B(R157)	C127A	R-GN	7-.010	C3-D7---D1
112	SB#1T(R134)	R135A	OR-BLX	7-.010	H3-C3-D8-D-A2
113	SB#5T(R139)	C119B	R-R	7-.010	M-H3-C3-D6
114	SB#5B(R138)	X 107 #5	GN-GNX	7-.010	M-H3-C3-D6
115	X107#8	S102	OR-BNX	7-.010	D-H4-D
116	GND #9	S102	W	7-.010	D-H4-D
117					
118	C137A	L104 #2	OR-OR	7-.010	D1
119	L104 #2	L106 #1	OR-OR	7-.010	DIRECT
120	L106 #2	X111 #2	R-GN	7-.010	D1-D-
121	T102 #14	S101	OR-BNX	7-.010	D---H4-D
122	F101 B	S101	GN-BL	7-.010	D
123	S101	T102 #15	R-ORX	7-.010	D---H4-D
124	SB#11B(R146)	R144 B	GN-BK	7-.010	H2-C3-C6
125	SB#11B(R146)	C119C	GN-BK	7-.010	M-H3-C3-D8
126					
127					
128	LB#5B(R168)	R167C	R-GN	7-.010	C- -A-A2
129	SB#8B(R170)	C115C	R-BK	7-.010	H2-C3-C4-C-B2
130	LB#4B(R118)	R117C	BL-BNX	7-.010	C---A-A3
131	LB#3B(R126)	C115B	R-BL	7-.010	C-B2
132	LB#3B(R126)	J101A	R-BL	7-.010	C---A-A2
133	LB#3T(R126)	T-101 #2	JUMP-S	#18 TIN	-
134	LB#2B(R101)	SB#7T(R171)	BK-R	7-.010	C-C1-C3-H3-M
135	LB#2T(R101)	T101 #4	JUMP-S	#18 TIN	-
136	LB#6B(R106)	X102 #4	OR-BK	7-.010	C
137	LB#7B(R107)	L-103 #2	JUMP-S	#18 TIN	-
138	LB#10T(R112)	X103 #2	R-R	7-.010	C-C4
139	X118A	X117B	JUMP-S	#18 TIN	DIRECT
140	LB#5T(R168)	X117B	R-R	7-.010	C-B2

JUMPER WIRES MARKED WITH S ARE COVERED WITH 18 FIBERGLASS SLEEVING ITEM NO.28 DWG.7714824

AN 16-35TS148-5

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
141	LB#19T(R177)	X112#4	GN-GN	7-010	C-C8-C6
142	LB#19B(R177)	X112#9	OR-BK	7-010	C-C6
143	X112 #3	C137 B	OR-BK	7-.010	-C8-D -D1
144	C137 B	L104	OR-BK	7-.010	D1
145	LB#21T(R178)	X113 #4	R-GN	7-.010	C-D
146	LB#21T(R178)	R182 B	R-GN	7-.010	C-B6
147	LB#9B(R109)	C140A	BN BN	7-.010	C-B2
148	LB#22T(R179)	X114 B	R-BK	7-.010	C *
149	X114B	X113 #5	R-BK	7-.010	D
150	X113 #5	X113 #3	JUMPER	#18 TIN	-
151	LB#24T(R181)	X113 #6	OR-OR	7-.010	C-D
152	LB#24B(R181)	R182A	BL-BL	7-.010	C-B6
153	L08 (R184)	C125A	GN-BNX	7-.010	J-D-K
154	L08 (R184)	R187-B	GN-BL	7-.010	J-D-H4-A2
155	R167 A	LB#16B(R166)	BK-BN	7-.01C	C---A--A2
156	LB#16B(R166)	X116 A	BK-BN	7-.010	C-B3-B
157	LB5T(R168)	SB#ST(R169)	R-R	7 -.010	C-C4-H2
158	L08 (R184)	723A CAP	GN-BN	7-.010	DIRECT
159	L08 (R152L)	C124 B	GN-BNX	7-.010	J-B-H4-D
160	L08 (R162)	R159C	BL-BNX	7-.010	J-D-H4-A2
161	L08 (R154)	R158A	R-RX	7-.010	J-D-H4-A2
162	X107 #8	C135B	OR-BKX	7-.010	D-D6-C3-C1-B-B1
163	GND #9	R127-A	W	7-.010	-A2-D
164	R127A	R133C	W	7-.010	A2-
165	R133C	GND ON J101C-(GND)	W	7-.010	A2
166	L101 #1	X101 #8	JUMP-S	#18 TIN	-
167	MB#3B(R132)	X106 #5	JUMP-S	#18 TIN	-
168	MB#3T(R132)	R133A	BL-BL	7-.010	C8-C1-A-A2
169	R133B	R133A	JUMPER	#18 TIN	-
170	X106#4	R127B	BL-BN	7-.010	C10-C3-D6-D-A2
171	X106#5	X106#3	JUMPER	#18 TIN	-
172	R140B	X106#1	JUMP-S	#18 TIN	-
173	X101#4	T101#3	JUMPER	#18 TIN	DIRECT
174	X102#6	L102#2	JUMPER	#18 TIN	DIRECT
175	X102 #3	L103 #1	JUMP-S	#18 TIN	DIRECT
176	X103 #6	X104 #6	BK-BL	7-.010	DIRECT
177	X109 #2	X109 #5	JUMPER	#18 TIN	-
178	X109 #5	C128	BL-BKX	7-.010	C8-C6-C-B3
179	X113 #8	X112 #5	GN-BN	7-.010	C8
180	X112 #5	LB 20T(R176)	GN-BN	7-.010	C8-C6-C
181	C135A	CAP 2X2	BK-BLX	7-.010	B1-B---C1-C3-D7-H6
182	C134 B	R163A	R-GN	7-.010	B1-B-A-A2
183	R163B	C117A	OR-BL	7-.010	A2-A---C-B5
184	C117A	HVB (R124)	JUMP-S	#18 TIN	DIRECT
185	C117B	HVB#4(R125)	JUMP-S	#18 TIN	DIRECT
186	C117B	R165B	OR-OR	7-.010	B5-C-B3-B-A-A2
187	HVB(R124)	C128A	R-BLX	7-.010	B-B3
188	HVB	HVB	JUMPER	#18 TIN	-
189	C116B	LB#14B(R191)	BK-BN	7-.010	B1-B-B3-C
190	X117A	X116B	JUMP-S		-
191	S101	J102	BN-BN	7-.010	D-H5-C1-B-B1
192					
193	R117A	LB#14T(R191)	R-ORX	7-.010	A3-A---C
194	LB#17B(R116)	R165A	GN-BK	7-.010	C---A-A2
195	J101B	R127C	R-GN	7-.010	-A2
196	C125B	R153B	OR-BKX	7-.010	K-H4-A2
197	R135C	C120A	OR-BNX	7-.010	A2-D-D6
198	C120A	C122	JUMPER	#18 TIN	-
199	R135B	R135A	JUMPER	#18 TIN	-
200	T102 #5	X111 #4	GN-BN	7-.010	D7-D
201	T102 #7	X111 #6	OR-GN	7-.010	D7-D
202	LB-1ET@LANK)	R117B	OR-BNX	7-.010	C---A-A3
203	X107 #4	R140C	BK-BNX	7-.010	D6-C3-C4
204	X106 #1	GND #6	JUMP-S	#18 TIN	DIRECT
205	X109 #6	C121B	JUMP-S	#18 TIN	DIRECT
206	C121A	HVB (R125)	R-ORX	7-.010	D-C----B
207	I-101B1	I-102B1	BK-BK	7-.010	DIRECT
208	I-101B2	I-102B2	BK-BK	7-.010	DIRECT
209	F101B	J102	BK-BL	7-.010	D-H5-C1-B-B1
210	X113 #1	GND #7	W	7-.010	C3
211	X112 #1	MTG BASE LUG	JUMPER	#18 TIN	DIRECT
212	GND-RH-DOOR	C137 COMMON	W	10-.010	DIRECT
213	GND-LH DOOR	X118GND LUG	W	10-.010	B1-B

CABLES J-B1-D-D1-A2 SHOWN AS ═══ ARE COVERED WITH VERSIFLEX TUBING ITEM NO.29 & 30 DWG.7714824

Figure 7-14. Wiring Legend (Serial Nos. 26-174, and 176, 177, 179, 180, 181, 182, 185, 187, 192, 193, 195, 196, 197, 203, 208, 213, 218, 232, 238, 242, 262, and 339) (Dwg. 7300859-9)

Fig. 7-14

AN 16-35TS148-5

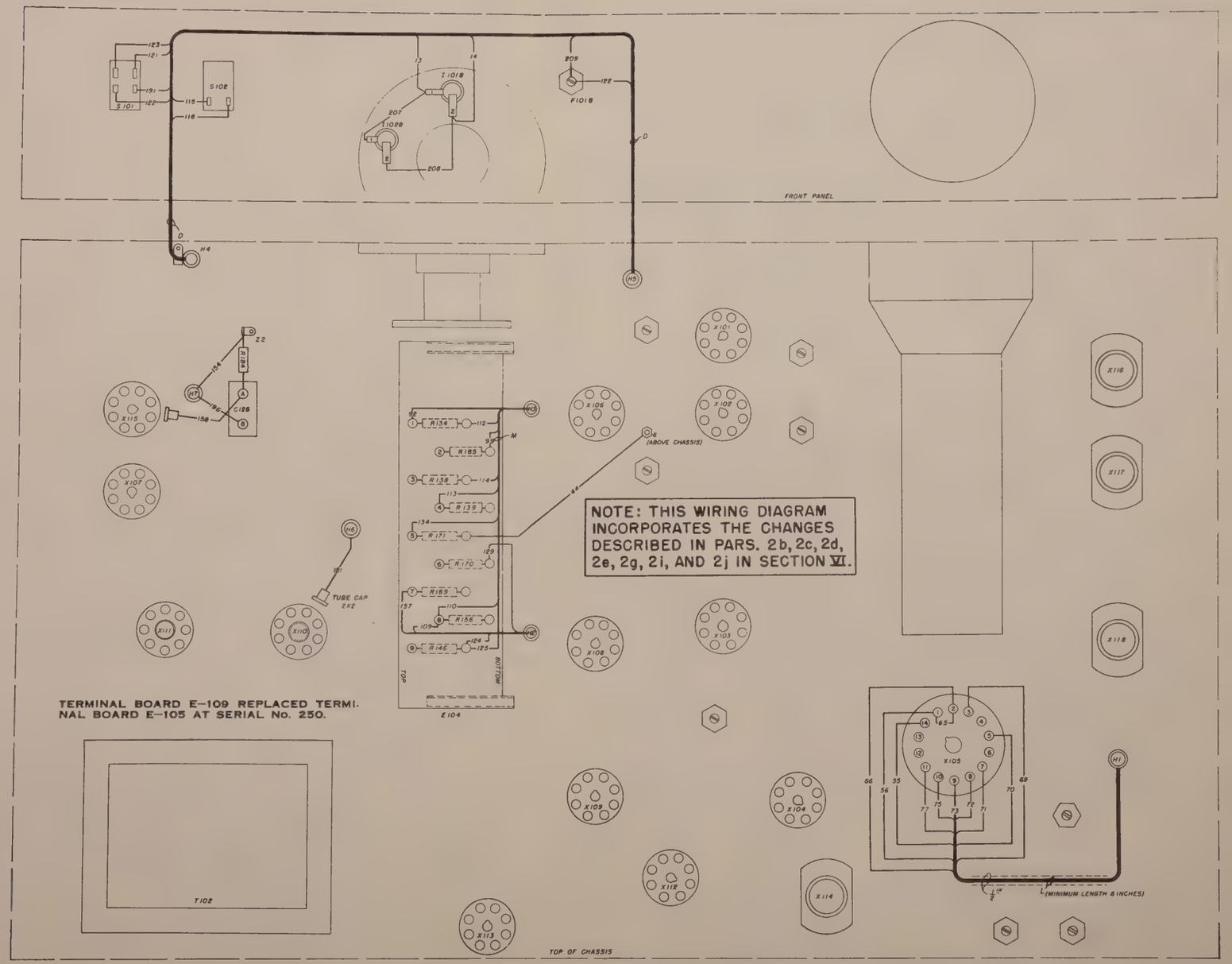
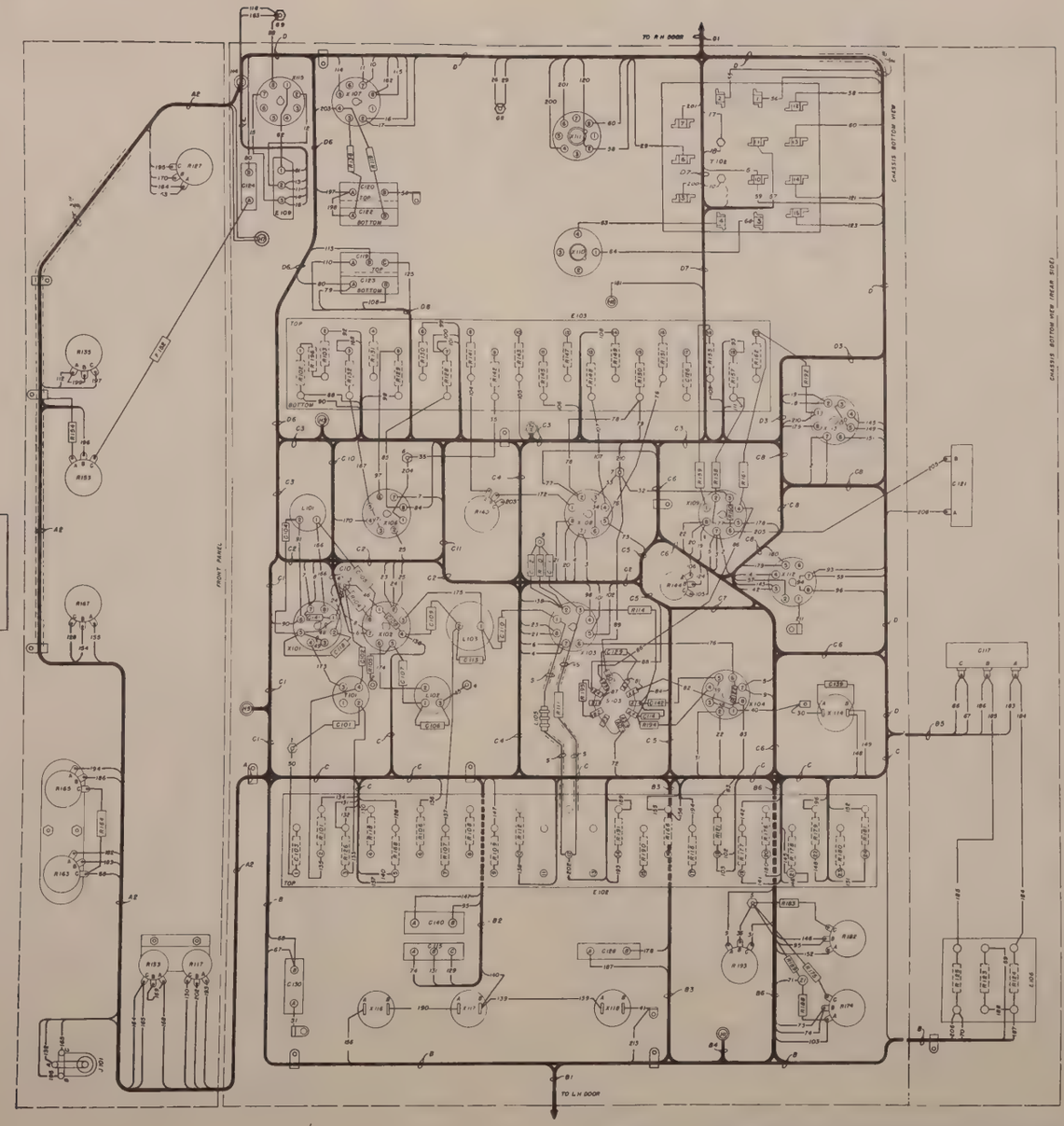


Figure 7-15. Wiring Diagram, Top of Chassis (Dwg. 7300859-10)
See Fig. 7-17 For Wiring Legend
(Serial Nos. 175-496)

Fig. 7-15

NOTE: R-175 WAS OMITTED AT SERIAL NO.175 AND R-174C WAS CONNECTED TO GROUND #5 WITH WIRE #27.



NOTE: THIS WIRING DIAGRAM INCORPORATES CHANGES DESCRIBED IN PARS. 2b, 2c, 2d 2e, 2g, 2i, 2j OF SECTION VI.

Figure 7-16. Wiring Diagram, Bottom of Chassis (Dwg. 7300859-10)
See Fig. 7-17 For Wiring Legend
(Serial Nos. 175-496)

Fig. 7-16

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
1	T102 #8	X113 #7	BK-BK	10-.010	D7,C3,C8
2	X113 #7	X108 #7	BK-BK	10-.010	C8-C6
3	X108 #7	X108 #7	BK-BK	10-.010	C6-C5-C2
4	X108 #7	X103 #7	BK-BK	10-.010	C2-C4
5	X109 #7	X104 #7	BK-BK	10-.010	C6
6	X103 #7	X102 #7	BK-BK	10-.010	C4-C2-C10
7	X108 #7	X101 #7	BK-BK	10-.010	C11-C2
8	X102 #7	X101 #7	BK-BK	10-.010	C10-C2
9	X104 #7	R193 A	BK-BK	10-.010	C6---B6
10	T102 #6	X107 #7	BK-BK	10-.010	D7---D
11	X107 #7	L.O.B. #2	BK-BK	10-.010	D-H4-D-J
12	LOB #2	X115 #2	BK-BK	10-.010	DIRECT
13	LOB #2	I-101 B1 SIDE	BK-BK	7-.010	J-D
14	I-101 B2	L.O.B. #3	BK-BK	7-.010	D-J
15	LOB #3	X115 #7	BK-BK	10-.010	DIRECT
16	LOB #3	X107 #2	BK-BK	10-.010	J-D-H4-D--
17	X107 #2	T102 #8	BK-BK	10-.010	D-----D7--
18	T102 #9	X113 #2	BK-BK	10-.010	D7-C3-C8
19	X113 #2	X109 #8	BK-BK	10-.010	D3-C3-C6
20	X109 #8	X108 #8	BK-BK	10-.010	C6-C5-C2
21	X108 #8	X103 #8	BK-BK	10-.010	C2-C4
22	X109 #8	X104 #2	BK-BK	10-.010	C6-C
23	X103 #8	X102 #2	BK-BK	10-.010	C4-C2
24	X102 #2	X101 #2	BK-BK	10-.010	C2-C10
25	X102 #2	X106 #2	BK-BK	10-.010	C2
26	GND #8	C137- COMMON	W	26-.010	D -D1
27					
28	GND #9	X115 #8	W	10-.010	DIRECT
29	GND #8	T102 #6	W	10-.010	D-
30	GND X114 LUG	X114A	JUMPER	#18 TIN	-
31	R193 C	X104 #2	BK-BK	10-.010	B6-C
32	X109 #3	GND #7	JUMPER	#18 TIN	-
33	GND #7	X108 #3	JUMPER	#18 TIN	-
34	X108 #3	X108 #6	JUMPER	#18 TIN	-
35	GND #6	WB # 9B(R142)	JUMPER-S	#18 TIN	-
36	R193B	GND #5	JUMPER	#18 TIN	-
37	C127 B	GND-LUG-BASE	JUMPER	#18 TIN	-
38	X104 #1	X104 #3	JUMPER	#18 TIN	-
39	X104 #3	X104 #5	JUMPER	#18 TIN	-
40	X104 #1	GND LUG BASE X134	JUMPER-S	#18 TIN	-
41	X118 B	GND LUG	JUMPER	#18 TIN	-
42	C116A	GND LUG-BASE	W	7-.010	
43					
44	3B #5B (R171)	GND #6 ABOVE CHASSIS	JUMPER-S	#18 TIN	
45	L102 #3	GND #4	JUMPER	#18 TIN	-
46	X102 #1	GND #3	JUMPER	#18 TIN	-
47	X101 #1	GND #3	JUMPER	#14 TIN	-
48	X101 #5	X101 #1	JUMPER	#14 TIN	-
49	X101 #3	X101 #5	JUMPER	#18 TIN	-
50	LB#1T(C103)	GND #1	JUMP-S	#18 TIN	DIRECT
51	C130A	GND LUG-BASE	JUMPER	#18 TIN	-
52	C-134A	GND LUG-BASE	W	7-.010	B1
53					
54	C120 B	GND LUG-BASE	JUMPER	#18 TIN	
55	X105 #14	T102 #2	GN-GN	7-.010	L-H1-B4-B-B3-C-D
56	X105 #1	T102 #1	R-R	7-.010	SAME AS #55
57	T102 #11	X112 #2	BK-BN	7-.010	D7-C3-C8
58	T102 #12	X111 #2	R-GN	7-.010	D-
59	T102 #10	X112 #7	BK-BN	7-.010	D
60	T102 #13	X111 #8	OR-OR	7-.010	D
61	T102 #10	LOB #1	BK-BN	7-.010	-D7,---,D-H4-D-J
62	LOB #1	X115 #1	BK-BN	7-.010	DIRECT
63	T102 #4	X110 #4	BL-BN	7-.010	DIRECT
64	T102 #3	X110 #1	BL-BN	7-.010	DIRECT
65	X105 #1	X105 #2	R-R	7-.010	DIRECT
66	X105 #2	C117-C	R-R	7-.010	L-H1-B4-B-B3-C-B5
67	C117C	C130 B	R-R	7-.010	B5-C-B3-B
68	C130 B	R163-C	R-R	7-.010	B-A-A2
69	X105 #3	HVB (R123)	BK-BNX	7-.010	L-H1-B4-B
70	X105 #5	HVB (R125)	R-ORX	7-.010	L-H1-B4-B

WIRES MARKED WITH X ARE SHIELDED WITH TINNED COPPER BRAID ITEM NO.27 DWG.7714824

AN 16-35TS148-5

NOTE: THIS WIRING LEGEND INCORPORATES CHANGES DESCRIBED IN PARS.2b,2c,2d 2e,2g,2i,2j OF SECTION VI.

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
71	X105 #7	Z-1	R-GN	7-.010	L-H1-B4-B-B6
72	X105 #8	S103-0A	OR-GNX	7-.010	L-H1-B4-B-B3-C
73	X105 #9	R174 B	OR-BL	7-.010	L-H1-B4-B6
74	R174-B	C115A	OR-BL	7-.010	B6-C-B2
75	X105 #10	X108 #5	OR-BNX	7-.010	L-H1-B4-B3-C5
76	X108 #5	MB#16 B(R151)	JUMP-S	#18 TIN	-
77	X105 #11	X108 #2	OR-BNX	7-.010	L-H1-B4-B3-C5-C8
78	X108 #2	MB #15B (R150)	JUMP-S	#18 TIN	-
79	MB#15B(R150)	C128 A	OR-BNX	7-.010	C3-D8
80	C123A	C124 B	OR-BNX	7-.010	- -D8-D
81	S103 A2	S103 A3	JUMPER	#18 TIN	-
82	S103 A2	X104 #8	JUMP-S	#18 TIN	-
83	X104 #8	LB #1Bs (R121)	JUMP-S	#18 TIN	-
84	S103 A1	X106 #8	GN-BLX	7-.010	C5-C2-C11-C3
85	X106 #8	MB#7B (R128)	JUMP-S	#18 TIN	-
86	S103-B5	X109 #4	JUMP-S	#18 TIN	-
87	S103-B1	S103 B5	JUMP-S	#18 TIN	-
88	S103 B4	MB#1B (R101)	R-BL	7-.010	C5-C6-C3
89	S103 B0	GND #7	JUMP-S	#18 TIN	DIRECT
90	MB # 1B(R102)	X101 #6	BL-BN	7-.010	C3-C1
91	X101 #6	L101 #2	JUMP-S	#18 TIN	-
92	MB #2T(R103)	SB#1B(R134)	BK-BN	7-.010	C3-H3
93	MB #19T (R157)	X112 #7	BK-BN	7-.010	C3-C8-D
94	X112 #7	X112 #8	JUMPER	#18 TIN	-
95	R182B	C140 B	R-GN	7-.010	B6-C-B2
96	X112 #8	LB #22B(R179)	BK-BN	7-.010	D-C
97	MB#5T(R129)	X106 #6	JUMP-S	#18 TIN	-
98	MB#5B (R129)	X103 #4	BK-BN	7-.010	C3-C4-C2
99	MB#6T(R130)	SB #2B (R185)	R-GN	7-.010	C3-H3
100	MB#7T(R128)	C137-C	R-BK	7-.010	C3-D7-D1
101	MB#7T(R128)	X103#5	R-BK	7-.010	C3-C4-C2
102	X103#5	LB#18T(R121)	R-BK	7-.010	C2-C5-C
103	LB#18T(R121)	R174A	R-BK	7-.010	C-B6
104	MB#8B(R141)	R140 A	JUMP-S	#18 TIN	-
105	MB#10B(R143)	R144C	BL-BL	7-.010	C3-C6
106	MB#11B(R145)	R144A	GN-BN	7-.010	C3-C6
107	X106#4	MB 1B (R146)	JUMP-S	#18 TIN	DIRECT
108	MB#14T(R149)	C123B	GN-BLX	7-.010	C3-D8
109	MB#18B(R155)	SB# 8T(R156)	OR-GN	7-.010	C3-H2
110	SB# 8T(R156)	C119 A	OR-GN	7-.010	M-H8-C3-D8
111	MB#19B(R157)	C127A	R-GN	7-.010	C3-D7----D1
112	SB#1T(R134)	R135A	OR-BLX	7-.010	H3-C3-D6-D-A2
113	SB#4T(R139)	C119B	R-R	7-.010	M- H3-C3-D6
114	SB#3B(R138)	X 107 #5	GN-GNX	7-.010	M- H3-C3-D6
115	X107#8	S102	OR-BKX	7-.010	D-H4-D
116	GND #9	S102	W	7-.010	D-H4-D
117					
118	C137A	L104 #2	OR-OR	7-.010	D1
119	L104 #2	L106 #1	OR-OR	7-.010	DIRECT
120	L106 #2	X111 #2	R-GN	7-.010	D1-D
121	T102 #14	S101	OR-BNX	7-.010	D---H4-D
122	F101 B	S101	GN-BL	7-.010	D
123	S101	T102 #15	R-ORX	7-.010	D---H4-D
124	SB# 9B(R146)	X144 B	GN-BK	7-.010	H2-C3-C6
125	SB# 9B(R146)	C119C	GN-BK	7-.010	M- H3-C3-D8
126					
127					
128	LB#5B(R169)	R167C	R-GN	7-.010	C- -A-A2
129	SB#6B(R170)	C115C	R-BK	7-.010	H2-C3-C4-C-B2
130	LB#4B(R118)	R117C	BL-BNX	7-.010	C---A-A3
131	LB#3B(R126)	C115B	R-BL	7-.010	C-B2
132	LB#3B(R126)	J101A	R-BL	7-.010	C---A-A2
133	LB#3T(R126)	T-101 #2	JUMP-S	#18 TIN	-
134	LB#2B(R101)	SB#3T(R171)	BK-R	7-.010	C-C1-C3-H3-M
135	LB#2T(R101)	T101 #4	JUMP-S	#18 TIN	-
136	LB#6B(R106)	X102 #4	OR-BK	7-.010	C
137	LB#7B(R107)	L-103 #2	JUMP-S	#18 TIN	-
138	LB#10T(R112)	X103 #2	R-R	7-.010	C-C4
139	X118A	X117B	JUMP-S	#18 TIN	DIRECT
140	LB#3T(R168)	X117B	R-R	7-.010	C-B2

JUMPER WIRES MARKED WITH S ARE COVERED WITH 18 FIBERGLASS SLEEVING ITEM NO.28 DWG.7714824

AN 16-35TS148-5

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
141	LB#19T(R177)	X112#4	GN-GN	7-.010	C-C8-C8
142	LB#19B(R177)	X112#3	OR-BK	7-.010	C-C8
143	X112 #3	C137 B	OR-BK	7-.010	-C8-D -D1
144	C137 B	L104	OR-BK	7-.010	D1
145	LB#21T(R178)	X113 #4	R-GN	7-.010	C-D
146	LB#21T(R178)	R182 B	R-GN	7-.010	C-B6
147	LB#9B(R109)	C140 A	BN-BN	7-.010	C-B2
148	LB#22T(R179)	X114 B	R-BK	7-.010	C
149	X114B	X113 #5	R-BK	7-.010	D
150	X113 #5	X113 #3	JUMPER	#18 TIN	-
151	LB#24T(R181)	X113 #6	OR-OR	7-.010	C-D
152	LB#24B(R181)	R182A	BL-BL	7-.010	C-B6
153					
154	Z-2	R167-B	GN-BL	7-.010	H7-A2
155	R167 A	LB#16B(R166)	BK-BN	7-.010	C---A-A2
156	LB#16B(R166)	X116 A	BK-BN	7-.010	C-B3-B
157	LB3T(R168)	SB#1T(R169)	R-R	7-.010	C-C4-H2
158	C125A	723A CAP	GN-BN	7-.010	DIRECT
159					
160					
161					
162	X107 #8	C135B	OR-BNX	7-.010	D-D6-C3-C1-B-B1
163	GND #9	R127-A	W	7-.010	-A2-D
164	R127A	R133C	W	7-.010	A2-
165	R133C	GND ON J101C-(GND)	W	7-.010	A2
166	L101 #1	X101 #8	JUMP-S	#18 TIN	-
167	MB#3B(R132)	X106 #5	JUMP-S	#18 TIN	-
168	MB#3T(R132)	R133A	BL-BL	7-.010	C3-C1-A-A2
169	R133B	R133A	JUMPER	#18 TIN	-
170	X106#4	R127B	BL-BN	7-010	C10-C3-D8-D-A2
171	X106#5	X106#3	JUMPER	#18 TIN	-
172	R140B	X108#1	JUMP-S	#18 TIN	-
173	X101#4	T101#3	JUMPER	#18 TIN	DIRECT
174	X102#6	L102#2	JUMPER	#18 TIN	DIRECT
175	X102 #3	L103 #1	JUMP-S	#18 TIN	DIRECT
176	X103 #6	X104 #6	BK-BL	7-.010	DIRECT
177	X109 #2	X109 #5	JUMPER	#18 TIN	-
178	X109 #5	C128	BL-BNX	7-.010	C8-C6-C-B3
179	X113 #8	X112 #5	GN-BN	7-.010	C8
180	X112 #5	LB 20T(R176)	GN-BN	7-.010	C8-C6-C
181	C135A	CAP 2X2	BK-BLX	7-.010	B1-B---C1-C3-D7-H6
182	C134 B	R163A	R-GN	7-.010	B1-B-A-A2
183	R163B	C117A	OR-BL	7-.010	A2-A------C-B5
184	C117A	HVB (R124)	JUMP-S	#18 TIN	DIRECT
185	C117B	HVB#4(R125)	JUMP-S	#18 TIN	DIRECT
186	C117B	R165B	OR-OR	7-.010	B5-C-B3-B-A-A2
187	HVB(R124)	C128A	R-BLX	7-.010	B-B5
188	HVB	HVB	JUMPER	#18 TIN	-
189	C116 B	LB#14B(R191)	BK-BN	7-.010	B1-B-B3-C
190	X117A	X116B	JUMP-S		-
191	S101	J102	BN-BN	7-.010	D-H5-C1-B-B1
192					
193	R117A	LB#14T(R191)	R-ORX	7-.010	A3-A---C
194	LB#17B(R116)	R165A	GN-BK	7-.010	C---A-A2
195	J101B	R127C	R-GN	7-.010	-A2
196	C125 B	R153B	OR-BNX	7-.010	H7-A2
197	R135C	C120 A	OR-BNX	7-.010	A2-D-D6
198	C120 A	C122	JUMPER	#18 TIN	-
199	R135B	R135A	JUMPER	#18 TIN	-
200	T102 #5	X111 #4	GN-BN	7-.010	D7-D
201	T102 #7	X111 #6	OR-GN	7-.010	D7-D
202	LB-12T(BLANK)	R117B	OR-BNX	7-.010	C---A-A3
203	X107 #4	R140C	BK-BNX	7-.010	D6-C3-C4
204	X106 #1	GND #8	JUMP-S	#18 TIN	DIRECT
205	X109 #6	C121B	JUMP-S	#18 TIN	DIRECT
206	C121A	HVB (R125)	R-ORX	7-.010	D-C----B
207	I-101B1	I-102B1	BK-BK	7-.010	DIRECT
208	I-101B2	I-102B2	BK-BK	7-.010	DIRECT
209	F101B	J102	BK-BL	7-.010	D-H5-C1-B-B1
210	X113 #1	GND #7	W	7-.010	C3
211	X112 #1	MTG BASE LUG	JUMPER	#18 TIN	DIRECT
212	GND-RH-DOOR	C137 COMMON	W	10-.010	DIRECT
213	GND-LH DOOR	X118GND LUG	W	10-.010	B1-B

CABLES J-B1-D-D1-A2 SHOWN AS ═══ ARE COVERED WITH VERSIFLEX TUBING ITEM NO.29 & 30 DWG 7714824

Figure 7-17. Wiring Legend (Serial Nos. 175-496) (Dwg. 7300859-10)

Fig. 7-17

AN 16-35TS148-5

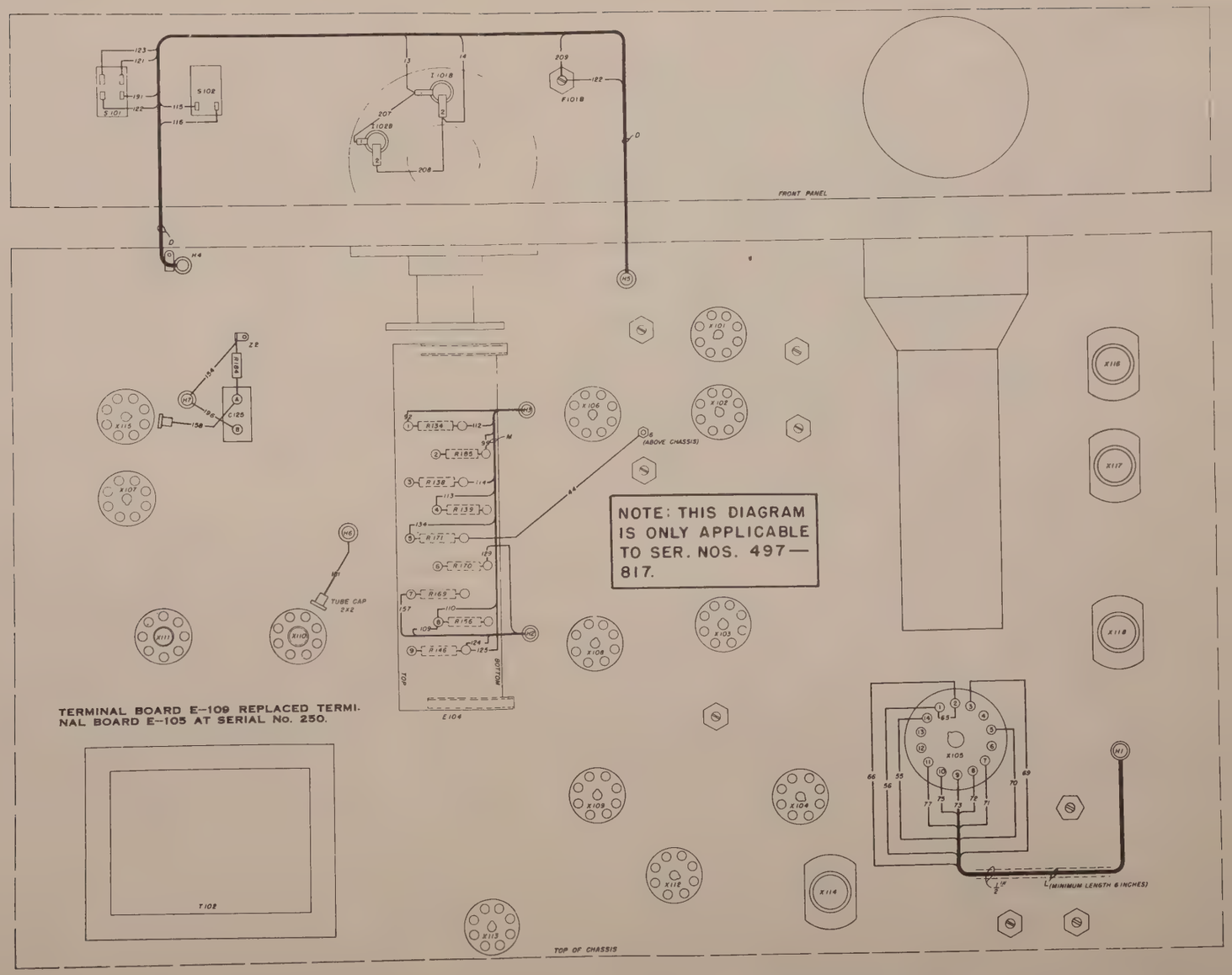
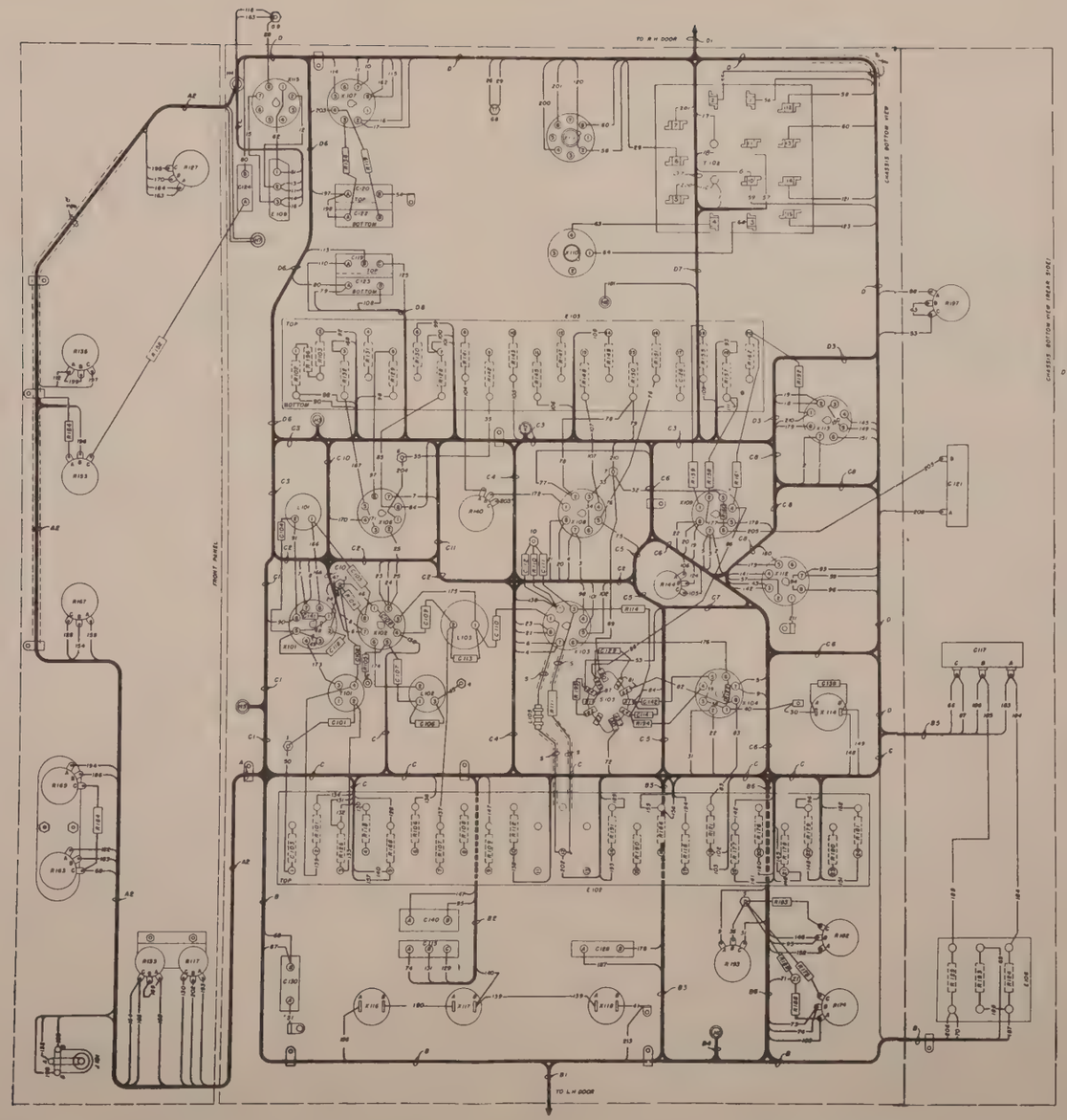
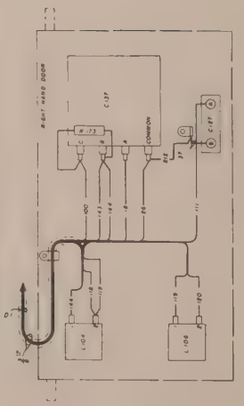


Fig. 7-18. Wiring Diagram, Top of Chassis (Dwg. 7300859-12)
See Fig. 7-20 For Wiring Legend
(Serial Nos. 497 to 817)

Fig. 7-18

AN 16-35TS148-5





NOTE: THIS DIAGRAM IS ONLY APPLICABLE TO SER. NOS. 497 — 817.

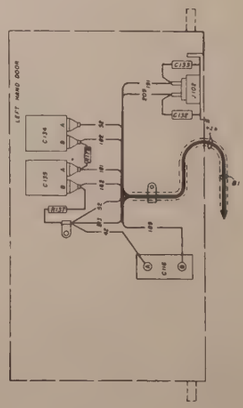


Figure 7-19. Wiring Diagram, Bottom of Chassis (Dwg. 7300859-12)
See Fig. 7-20 For Wiring Legend (Serial Nos. 497 to 817)

Fig. 7-19

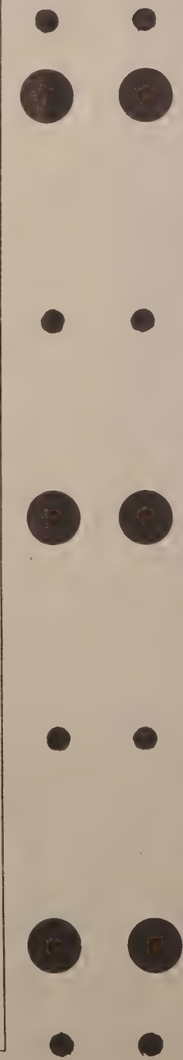
AN 16-35TS148-5
AN 16-35TS148-5
AN 16-35TS148-5

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
1	T102 #8	X113 #7	BK-BK	10-.010	D7,C3,C8
2	X113 #7	X109 #7	BK-BK	10-.010	C8-C6
3	X109 #7	X108 #7	BK-BK	10-.010	C6-C5-C2
4	X108 #7	X103 #7	BK-BK	10-.010	C2-C4
5	X109 #7	X104 #7	BK-BK	10-.010	C6
6	X109 #7	X102 #7	BK-BK	10-.010	C4-C2-C10
7	X106 #7	X101 #7	BK-BK	10-.010	C11-C2
8	X102 #7	X101 #7	BK-BK	10-.010	C10-C2
9	X104 #7	R193 A	BK-BK	10-.010	C6---B6
10	T102 #8	X107 #7	BK-BK	10-.010	D7---D
11	X107 #7	L.O.8. #2	BK-BK	10-.010	D-H4-D-J
12	LOB #2	X115 #2	BK-BK	10-.010	E-H4-E
13	LOB #2	I-101 B1 SIDE	BK-BK	7-.010	J-D
14	I-101 B2	L.O.B. #3	BK-BK	7-.010	D-J
15	LOB #3	X115 #7	BK-BK	10-.010	E-H4-E
16	LOB #3	X107 #2	BK-BK	10-.010	J-D-H4-D--
17	X107 #2	T102 #9	BK-BK	10-.010	D-----D7--
18	T102 #9	X113 #2	BK-BK	10-.010	D7-C3-D8
19	X113 #2	X109 #8	BK-BK	10-.010	D3-C3-C6
20	X109 #8	X108 #8	BK-BK	10-.010	C6-C5-C2
21	X108 #8	X103 #8	BK-BK	10-.010	C2-C4
22	X109 #8	X104 #2	BK-BK	10-.010	C6-C
23	X103 #8	X102 #2	BK-BK	10-.010	C4-C2
24	X102 #2	X101 #2	BK-BK	10-.010	C2-C10
25	X102 #2	X106 #2	BK-BK	10-.010	C2
26	GND #8	C137- COMMON	W	26-.010	D -D1
27	GND #9	LOB (R154)	W	10-.010	D-H4
28	LOB (R154)	X115 #8	W	10-.010	E-H4-E
29	GND #8	T102 #6	W	10-.010	D-
30	GND X114 LUG	X114A	JUMPER	#16 TIN	-
31	R193 C	X104 #2	BK-BK	10-.010	B6-C
32	X109 #3	GND #7	JUMPER	#18 TIN	-
33	GND #7	X108 #3	JUMPER	#18 TIN	-
34	X108 #3	X108 #6	JUMPER	#18 TIN	-
35	GND #6	MB # 9B(R142)	JUMPER-S	#18 TIN	-
36	R193B	GND #5	JUMPER	#18 TIN	-
37	C127 B	GND-LUG-BASE	JUMPER	#18 TIN	-
38	X104 #1	X104 #3	JUMPER	#18 TIN	-
39	X104 #3	X104 #5	JUMPER	#18 TIN	-
40	X104 #1	GND LUG BASE X-114	JUMPER-S	#18 TIN	-
41	X118 B	GND LUG	JUMPER	#18 TIN	-
42	C116A	GND LUG-BASE	W	7-.010	
43					
44	SB #7B (R171)	GND #6 ABOVE CHASSIS	JUMPER-S	#18 TIN	
45	L102 #3	GND #4	JUMPER	#18 TIN	-
46	X102 #1	GND #3	JUMPER	#18 TIN	-
47	X101 #1	GND #3	JUMPER	#14 TIN	-
48	X101 #5	X101 #1	JUMPER	#14 TIN	-
49	X101 #3	X101 #5	JUMPER	#18 TIN	-
50	LB#1T(C103)	GND #1	JUMP-S	#18 TIN	DIRECT
51	C190A	GND LUG-BASE	JUMPER	#18 TIN	-
52	C-134A	GND LUG-BASE	W	7-.010	B1
53					
54	C120 B	GND LUG-BASE	JUMPER	#18 TIN	
55	X105 #14	T102 #2	GN-GN	7-.010	L-H1-B4-B-B3-C-D
56	X105 #1	T102 #1	R-R	7-.010	SAME AS #55
57	T102 #11	X112 #2	BN-BN	7-.010	D7-C3-C8
58	T102 #12	X111 #2	R-GN	7-.010	D-
59	T102 #10	X112 #7	BN-BN	7-.010	D
60	T102 #13	X111 #8	OR-OR	7-.010	D
61	T102 #10	LOB #1	BN-BN	7-.010	-D7,---,D-H4-D-J
62	LOB #1	X115 #1	BN-BN	7-.010	E-H4-E
63	T102 #4	X110 #4	BL-BN	7-.010	DIRECT
64	T102 #3	X110 #1	BL-BN	7-.010	DIRECT
65	X105 #1	X105 #2	R-R	7-.010	DIRECT
66	X105 #2	C117-C	R-R	7-.010	L-H1-B4-B-B3-C-B5
67	C117C	C130 B	R-R	7-.010	B5-C-B3-B
68	C130 B	R163-C	R-R	7-.010	B-A-A2
69	X105 #3	HVB (R123)	BK-BNX	7-.010	L-H1-B4-B
70	X105 #5	HVB (R125)	R-ORX	7-.010	L-H1-B4-B

WIRES MARKED WITH X ARE SHIELDED WITH TINNED COPPER BRAID ITEM NO.27 DWG.7714824

NOTE: THIS WIRING LEGEND IS APPLICABLE ONLY TO SER. NO. 497-817.

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
71	X105 #7	Z-1	R-GN	7-.010	L-H1-B4-B-B6
72	X105 #8	S103-OA	OR-BNX	7-.010	L-H1-B4-B-B3-C
73	X105 #9	R174 B	OR-BL	7-.010	L-H1-B4-B6
74	R174-B	C118A	OR-BL	7-.010	B6-C-B2
75	X108 #10	X108 #5	OR-BNX	7-.010	L-H1-B4-B3-C5
76	X108 #5	MB#1F R(R151)	JUMP-S	#18 TIN	-
77	X105 #11	X108 #2	OR-BNX	7-.010	L-H1-B4-B3-C5-C6
78	X108 #2	MB #15B (R150)	JUMP-S	#18 TIN	-
79	MB#15B(R150)	C123 A	OR-BNX	7-.010	C3-D8
80	C123A	C124A	OR-BNX	7-.010	--D6-D
81	S103 A2	S103 A3	JUMPER	#18 TIN	-
82	S103 A2	X104 #8	JUMP-S	#18 TIN	-
83	X104 #8	LB #1B8 (R121)	JUMP-S	#18 TIN	-
84	S103 A1	X106 #8	GN-BLX	7-.010	C5-C2-C11-C3
85	X106 #8	MB#7B(R128)	JUMP-S	#18 TIN	-
86	S103-B5	X109 #4	JUMP-S	#18 TIN	-
87	S103-R1	S103 B5	JUMP-S	#19 TIN	-
88	S103 B4	MB#1B (R104)	R-BL	7-.010	C5-C6-C3
89	S103 B0	GND #7	JUMP-S	#18 TIN	DIRECT
90	MB # 1B(R102)	X101 #6	BL-BN	7-.010	C3-C1
91	X101 #6	L101 #2	JUMP-S	#18 TIN	-
92	MB #2T(R103)	SB#1B(R134)	BN-BN	7-.010	C3-H3
93	MB #19T (R157)	X112 #7	BN-BN	7-.010	C3-C8-D
94	X112 #7	X112 #8	JUMPER	#18 TIN	-
95	R182B	C140B	R-GN	7-.010	B6-C-B2
96	X112 #8	LB #22B(R179)	BN-BN	7-.010	D-C
97	MB#5T(R129)	X106 #6	JUMP-S	#18 TIN	-
98	MB#5B (R129)	X103 #4	BK-BN	7-.010	C3-C4-C2
99	MR#6T(R130)	SB #2B (R185)	R-GN	7-.010	C3-H3
100	MB#7T(R128)	C137-C	R-RK	7-.010	C3-D7-D1
101	MR#7T(R128)	X103#5	R-BK	7-.010	C3-C4-C2
102	X103#5	LB#1B7(R121)	R-BK	7-.010	C2-C5-C
103	LB#1BT(R121)	R174A	R-BK	7-.010	C-B6
104	MB#8B(R141)	R140 A	JUMP-S	#18 TIN	-
105	MB#10B(R143)	R144C	BL-BL	7-.010	C3-C6
106	MB#11B(R145)	R144A	GN-BN	7-.010	C3-C6
107	X108#4	MB 3B(R148)	JUMP-S	#18 TIN	DIRECT
108	MB#14T(R149)	C123B	GN-BLX	7-.010	C3-D8
109	MR#18B(R155)	SB#10T(R156)	OR-GN	7-.010	C3-H2
110	SB#10T(R156)	C119 A	OR-GN	7-.010	M-H3-C3-D8
111	MB#19B(R157)	C127A	R-GN	7-.010	C3-D7----D1
112	SB#1T(R134)	R135A	OR-BLX	7-.010	H3-C3-D8-D-A2
113	SB#6T(R139)	C119B	R-R	7-.010	M-H3-C3-D6
114	SB#5B(R138)	X 107 #5	GN-GNX	7-.010	M-H3-C3-D6
115	X107#8	S102	OR-BKX	7-.010	D-H4-D
116	GND #9	S102	W	7-.010	D-H4-D
117					
118	C137A	L104 #2	OR-OR	7-.010	D1
119	L104 #2	L106 #1	OR-OR	7-.010	DIRECT
120	L106 #2	X111 #2	R-GN	7-.010	D1-D-
121	T102 #14	S101	OR-RNX	7-.010	D---H4-D
122	F101 B	S101	GN-RL	7-.010	D
123	S101	T102 #15	R-ORX	7-.010	D---H4-D
124	SB#11B(R146)	R144 B	GN-BK	7-.010	H2-C3-C6
125	SB#11B(R146)	C119C	GN-BK	7-.010	M-H3-C3-D8
126					
127					
128	LB#5B(R168)	R167C	R-GN	7-.010	C- -A-A2
129	SB#8B(R170)	C115C	R-RK	7-.010	H2-C3-C4-C-B2
130	LB#4B(R118)	R117C	BL-BNX	7-.010	C---A-A3
131	LB#3B(R126)	C115B	R-RL	7-.010	C-B2
132	LB#3B(R126)	J101A	R-RL	7-.010	C---A-A2
133	LB#3T(R126)	T-101 #2	JUMP-S	#18 TIN	-
134	LB#2B(R101)	SB#7T(R171)	RK-R	7-.010	C-C1-C3-H3-M
135	LB#2T(R101)	T101 #4	JUMP-S	#18 TIN	-
136	LB#6B(R106)	X102 #4	OR-BK	7-.010	C
137	LB#7B(R107)	L-103 #2	JUMP-S	#18 TIN	-
138	LB#10T(R112)	X103 #2	R-R	7-.010	C-C4
139	X118A	X117B	JUMP-S	#18 TIN	DIRECT
140	LB# 5T(R168)	X117B	R-R	7-.010	C-B2



WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
141	LB#19T(R177)	X112#4	GN-GN	7-.010	C-C6-C8
142	LB#19B(R177)	X112#9	OR-BK	7-.010	C-C6
143	X112 #3	C137 B	OR-BY	7-.010	C8-D -D1
144	C137 B	L104	OR-BK	7-.010	D1
145	LB#21T(R178)	X113 #4	R-GN	7-.010	C-D
146	LB#21T(R178)	R182 B	R-GN	7-.010	C-B6
147	LB#9B(R109)	C140A	BN-BN	7-.010	C-B2
148	LB#22T(R179)	X114 B	R-BK	7-.010	C
149	X114B	X113 #5	R-BK	7-.010	D
150	X113 #5	X113 #3	JUMPER	#18 TIN	-
151	LB#24T(R181)	X113 #6	OR-OR	7-.010	C-D
152	LB#24B(R181)	R182A	BL-BL	7-.010	C-B6
153	LOB (R184)	C125A	GN-BNX	7-.010	J-D-K
154	LOB (R184)	R187-B	GN-BL	7-.010	J-D-H4-A2
155	R187 A	LB#18B(R186)	BK-BN	7-.010	C---A--AE
156	LB#16B(R186)	X116 A	BK-BN	7-.010	C-B5-B
157	LB5T(R168)	SB#3T(R169)	R-R	7 -.010	C-C4-H2
158	LOB (R184)	723A CAP	GN-BN	7-.010	DIRECT
159	LOB (R162L)	C124 B	GN-BNX	7-.010	J-D-H4-D
160	LOB (R182)	R159D	BL-BNX	7-.010	J-D-H4-A2
161	LOB (R154	R163A	R-RX	7-.010	J-D-H4-A2
162	X107 #6	C135 B	OR-BKX	7-.010	D-D6-C3-C1-B-B1
163	GND #9	R127-A	W	7-.010	-A2-D
164	R127A	R133C	W	7-.010	A2-
165	R133C	GND ON J101C-(GND)	W	7-.010	A2
166	L101 #1	X101 #8	JUMP-S	#18 TIN	-
167	MB#3B(R132)	X106 #5	JUMP-S	#18 TIN	
168	MB#3T(R132)	R133A	BL-BL	7-.010	C3-C1-A-A2
169	R133B	R133A	JUMPER	#18 TIN	-
170	X106#4	R127B	BL-BN	7-.010	C10-C3-B6-D-A2
171	X106#5	X106#3	JUMPER	#18 TIN	-
172	R14CB	X106#1	JUMP-S	#18 TIN	-
173	X101#4	T101#3	JUMPER	#18 TIN	DIRECT
174	X102#5	L102#2	JUMPER	#18 TIN	DIRECT
175	X102 #3	L103 #1	JUMP-S	#18 TIN	DIRECT
176	X103 #6	X104 #6	BK-BL	7-.010	DIRECT
177	X109 #2	X109 #5	JUMPER	#18 TIN	-
178	X109 #5	C128	BL-BKX	7-.010	C8-C6-C-B3
179	X113 #8	X112 #5	GN-BN	7-.010	C8
180	X112 #5	LB 2CT(R178)	GN-BN	7-.010	C8-C6-C
181	C135A	CAP 2X2	BK-BLX	7-.010	B1-B---C1-C3-D7-H6
182	C134 B	R163A	R-GN	7-.010	B1-B-A-A2
183	R163B	C117A	OR-BL	7-.010	A2-A---C-B5
184	C117A	HVB (R124)	JUMP-S	#18 TIN	DIRECT
185	C117B	HVB#4(R125)	JUMP-S	#18 TIN	DIRECT
186	C117B	R165B	OR-OR	7-.010	B5-C-B3-B-A-A2
187	HVB(R124)	C128A	R-BLX	7-.010	B-B5
188	HVB	HVB	JUMPER	#18 TIN	-
189	C116B	LB#14B(R191	BK-BN	7-.010	B1-B-B3-C
190	X117A	X116B	JUMP-S		-
191	S101	J102	BN-BN	7-.010	D-H5-C1-B-B1
192					
193	R117A	LB#14T(R191)	R-ORX	7-.010	A3-A---C
194	LB#17B(R116)	R165A	GN-BK	7-.010	C---A-A2
195	J101B	R127C	R-GN	7-.010	-A2
196	C125B	R153B	OR-BKX	7-.010	K-H4-A2
197	R135C	C120A	OR-BNX	7-.010	A2-D-D6
198	C120A	C122	JUMPER	#18 TIN	-
199	R135B	R136A	JUMPER	#18 TIN	-
200	T102 #5	X111 #4	BN-BN	7-.010	D7-D
201	T102 #7	X111 #6	OR-GN	7-.010	D7-D
202	LB-12T(BLANK)	R117B	OR-BNX	7-.010	C---A-A3
203	X107 #4	R140C	BK-BNX	7-.010	D6-C3-C4
204	X106 #1	GND #6	JUMP-S	#18 TIN	DIRECT
205	X109 #6	C121B	JUMP-S	#18 TIN	DIRECT
206	C121A	HVB. (R125)	R-ORX	7-.010	D-C----B
207	I-101A1	I-102B1	BK-BK	7-.010	DIRECT
208	I-101A2	I-102B2	BK-BK	7-.010	DIRECT
209	F101B	J102	BK-BL	7-.010	D-H6-C1-B-B1
210	X113 #1	GND #7	W	7-.010	C3
211	X112 #1	MTG BASE LUG	JUMPER	#18 TIN	DIRECT
212	GND-RH-DOOR	C137 COMMON	W	10-.010	DIRECT
213	GND-LH DOOR	X118 GND LUG	W	10-.010	B1-B

UMPER WIRES MARKED WITH S ARE COVERED WITH 18 FIBERGLASS SLEEVING ITEM NO 9B DWG.7714824

CABLES J-B1-D-D1-A2 SHOWN AS ═══ ARE COVERED WITH VERSIFLEX TUBING ITEM NO.29 & 30 DWG.7714824

Figure 7-20. Wiring Legend (Serial Nos. 497 to 817) (Dwg. 7300859-12)

Fig. 7-20

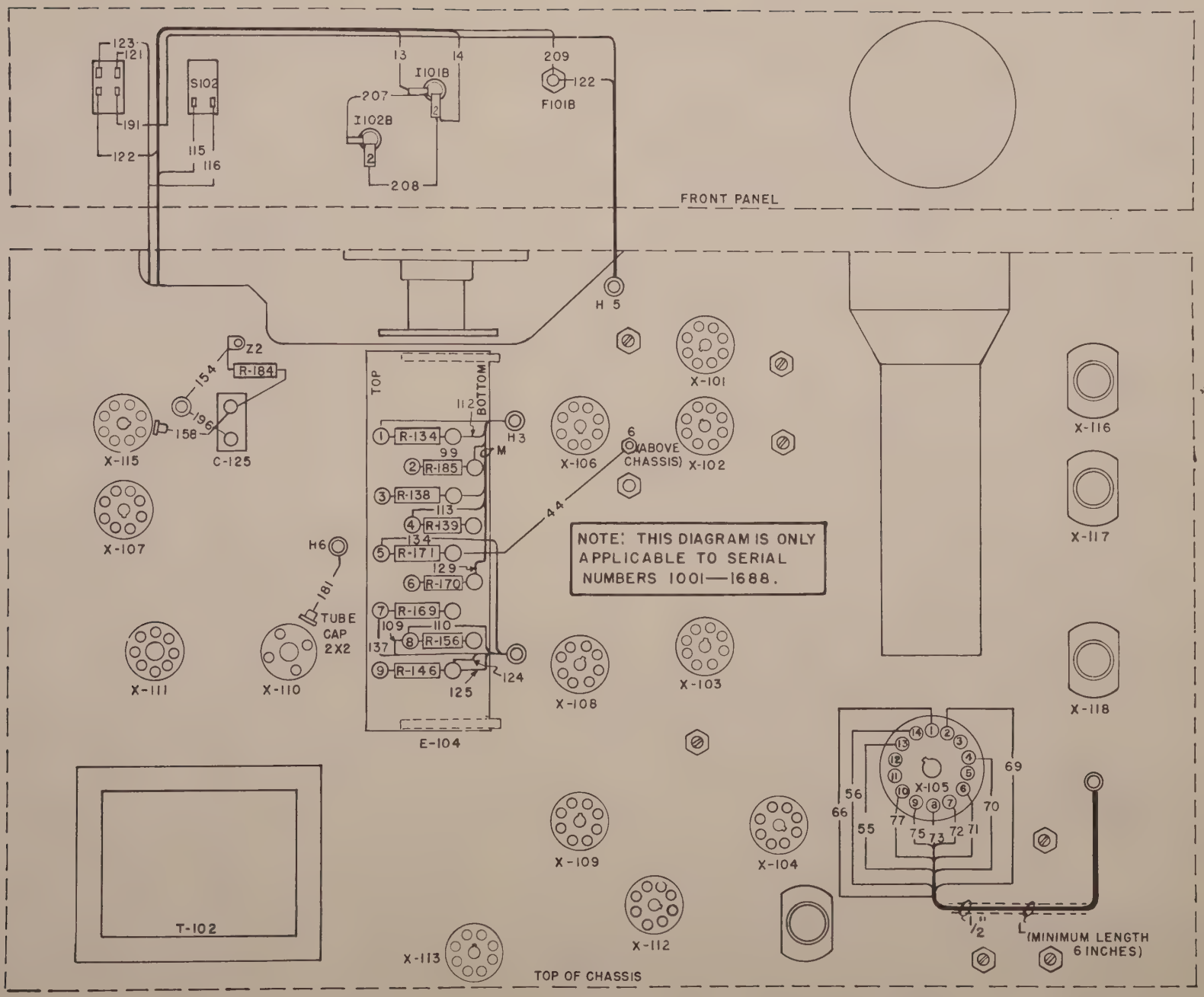


Figure 7-21. Wiring Diagram, Top of Chassis
See Fig. 7-22 For Wiring Legend
(Serial Nos. 1001 to 1688)

Fig. 7-21

Revised 1 August 1948

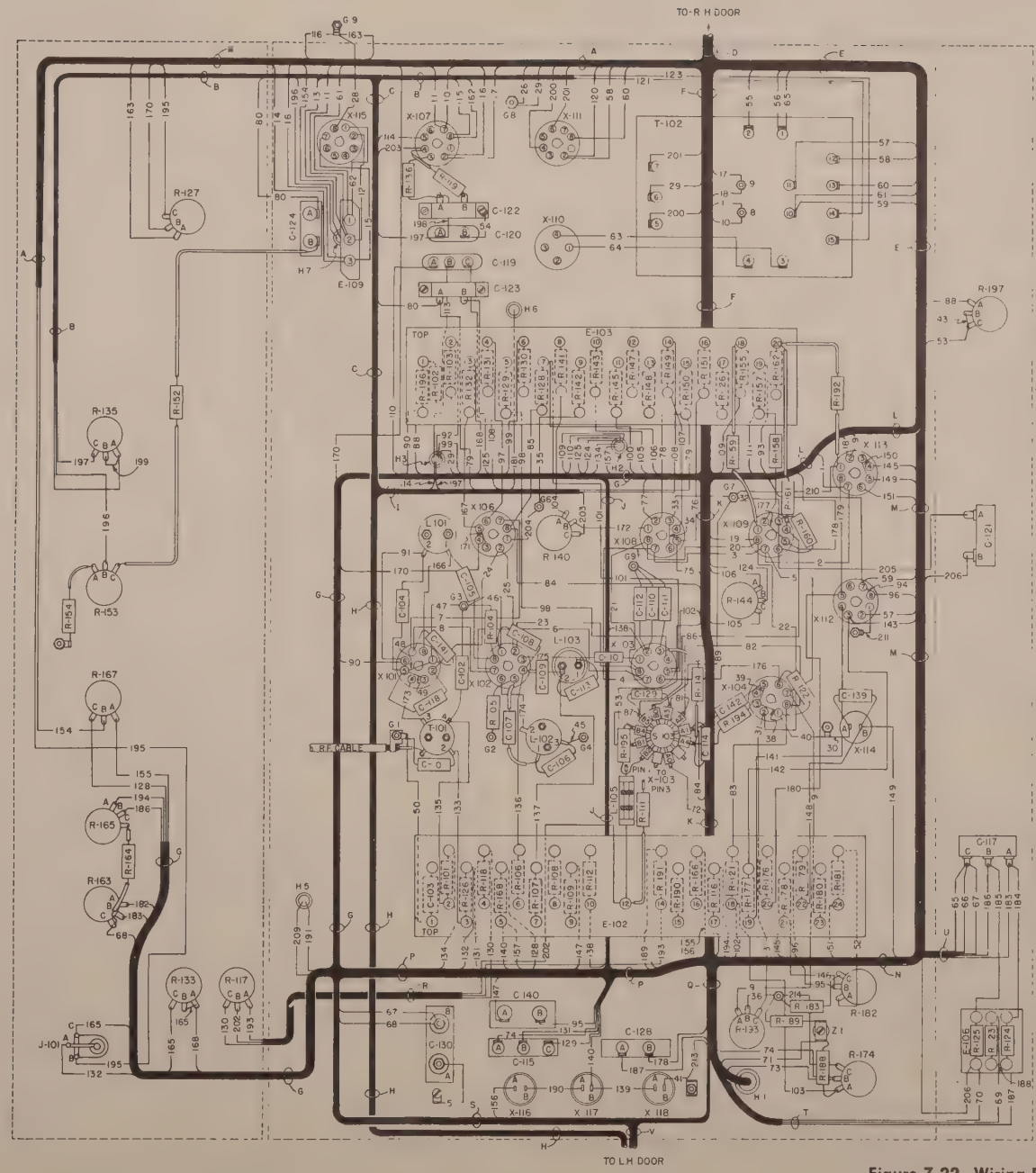


Figure 7-22. Wiring Diagram, Bottom of Chassis (Serial Nos. 1001 to 1688)

Fig. 7-22

AN 16-35TS148-5

AN 16-35TS148-5

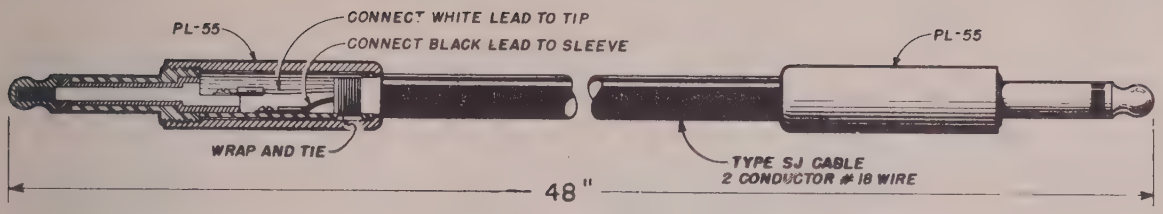
WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
1	T-102 #8	X-113 #7	W-BK	7-0.012	F-L
2	X-113 #7	X-109 #7	W-BK	7-0.012	DIRECT
3	X-109 #7	X-108 #7	W-BK	7-0.012	DIRECT
4	X-108 #7	X-103 #7	W-BK	7-0.012	DIRECT
5	X-109 #7	X-104 #7	W-BK	7-0.012	DIRECT
6	X-102 #7	X-103 #7	W-BK	7-0.012	DIRECT
7	X-106 #7	X-101 #7	W-BK	7-0.012	DIRECT
8	X-102 #7	X-101 #7	W-BK	7-0.012	DIRECT
9	X-104 #7	R-193 A	W-BK	7-0.012	DIRECT
10	T-102 #8	X-107 #7	W-BK	7-0.012	F-A
11	X-107 #7	E-109 #2	W-BK	7-0.012	A
12	E-109 #2	X-115 #2	W-BK	7.0.012	DIRECT
13	I-101 B1	E-109 #2	W-BK	7-0.010	B
14	I-101 B2	E-109 #3	W-BK	7-0.010	A
15	E-109 #3	X-115 #7	W-BK	7-0.012	DIRECT
16	X-107 #2	E-109 #3	W-BK	7-0.012	A-F
17	X-107 #2	T-102 #9	W-BK	7-0.012	A-F
18	X-113 #2	T-102 #9	W-BK	7-0.012	L-F
19	X-113 #2	X-109 #8	W-BK	7-0.012	L-K
20	X-109 #8	X-108 #8	W-BK	7-0.012	DIRECT
21	X-108 #8	X-103 #8	W-BK	7-0.012	DIRECT
22	X-109 #8	X-104 #2	W-BK	7-0.012	DIRECT
23	X-103 #8	X-102 #2	W-BK	7-0.012	DIRECT
24	X-106 #2	X-101 #2	W-BK	7-0.012	DIRECT
25	X-102 #2	X-106 #2	W-BK	7-0.012	DIRECT
26	C-137 COM	GND #8	W	7-0.020	D-A
27	Not used	--	--	--	--
28	X-115 #8	GND #9	W	7-0.012	DIRECT
29	T-102 #6	GND #8	W	7-0.012	F-A
30	X-104 #1	X-114 GND	JUMPER	#20 TIN	DIRECT
31	R-193 C	X-104 #2	W-BK	7-0.012	DIRECT
32	X-109 #3	GND #7	JUMPER	#20 TIN	DIRECT
33	GND #7	X-108 #3	JUMPER	#20 TIN	DIRECT
34	X-108 #3	X-108 #6	JUMPER	#20 TIN	DIRECT
35	R-142 (E-103)	GND #6	W	7-0.012	DIRECT
36	R-193 B	GND #5	JUMPER	#20 TIN	DIRECT
37	C-127 B	GND LUG	JUMPER	#20 TIN	DIRECT
38	X-104 #1	X-104 #3	JUMPER	#20 TIN	DIRECT
39	X-104 #3	X-104 #5	JUMPER	#20 TIN	DIRECT
40	X-104 #1	X-114 GND	JUMPER	#20 TIN	DIRECT
41	X-118 B	GND LUG	JUMPER	#20 TIN	DIRECT
42	C-116A	GND LUG	W	7-0.010	DIRECT
43	R-197C	R-197B	JUMPER	#20 TIN	DIRECT
44	R-171 (E-104)	GND #6	W-R	7-0.010	DIRECT
45	L-102 #3	GND #4	JUMPER	#20 TIN	DIRECT
46	X-102 #1	GND #3	JUMPER	#20 TIN	DIRECT
47	X-101 #1	GND #3	JUMPER	#14 TIN	DIRECT
48	X-101 #5	X-101 #1	JUMPER	#14 TIN	DIRECT
49	X-101 #3	X-101 #5	JUMPER	#20 TIN	DIRECT
50	C-103 (E-102)	GND #1	W-BK	7-0.010	DIRECT
51	C-130A	GND LUG	JUMPER	#20 TIN	DIRECT
52	C-134A	L.H. Door GND	W	7-0.012	V
53	R-197C	S-103 B4	W-BL	7-0.010	E-L-K
54	C-120B	GND LUG	JUMPER	#20 TIN	DIRECT

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
55	X-105 #14	T-102 #2	W-G	7-0.010	H1-O-N-M-E
56	X-105 #1	T-102 #1	W-R	7-0.010	H1-O-N-M-E
57	T-102 #11	X-112 #2	W-BN	7-0.010	E-M
58	T-102 #12	X-111 #2	W-R-G	7-0.010	E-A
59	T-102 #10	X-112 #7	W-BN	7-0.010	E-M
60	T-102 #13	X-111 #8	W-O	7-0.010	E-A
61	T-102 #10	E-109 #1	W-BN	7-0.010	E-A
62	E-109 #1	X-115 #1	W-BN	7-0.010	DIRECT
63	T-102 #4	X-110 #4	W-G-BN	7-0.010	DIRECT
64	T-102 #3	X-110 #1	W-G-RN	7-0.010	DIRECT
65	T-102 #1	C-117C	W-R	7-0.010	E-M-U
66	X-105 #2	C-117C	W-R	7-0.010	H1-O-N-M-U
67	C-130B	C-117C	W-R	7-0.010	F-N-U
68	C-130B	R-163C	W-R	7-0.010	Q
69	X-105 #3	R-123 (E-106)	W-BK-BN	7-0.010	H1-T
70	X-105 #5	R-125 (E-106)	W-R-BK	7-0.010	H1-T
71	X-105 #7	Z-1	W-R-G	7-0.010	H1-O
72	X-105 #8	S-103 A0	W-O-G	7-0.010	H1-O-N
73	X-105 #9	R-174B	W-O-BL	7-0.010	H1-O
74	R-174B	C-115A	W-O-BL	7-0.010	O-P
75	X-105 #10	X-108 #5	W-O-BK	7-0.010	H1-O-N
76	X-108 #5	R-151 (E-103)	W-O-BK	7-0.010	DIRECT
77	X-105 #11	X-108 #2	W-O-BN	7-0.010	H1-O-N-G
78	X-108 #2	R-150 (E-103)	W-O-BN	7-0.010	DIRECT
79	C-123A	R-150 (E-103)	W-O-BN	7-0.010	I
80	C-123A	C-124A	W-O-RN	7-0.010	C-B
81	S-103 A2	S-103 A3	JUMPER	#20 TIN	DIRECT
82	S-103 A2	X-104 #8	W-BL	7-0.010	DIRECT
83	X-104 #8	R-121 (E-102)	W-R-BK	7-0.010	DIRECT
84	S-103 A1	X-106 #8	W-G-BL	7-0.010	M
85	X-106 #8	R-128 (E-103)	W-G-BL	7-0.010	DIRECT
86	S-103 B5	X-109 #4	W-G	7-0.010	DIRECT
87	S-103 B5	S-103 B1	JUMPER	#20 TIN	DIRECT
88	R-197A	R-196 (E-103)	W-BL-BN	7-0.010	E-L-G
89	S-103 B0	GND #7	W	7-0.012	DIRECT
90	R-196 (E-103)	X-101 #6	W-BL-BN	7-0.012	G
91	X-101 #6	L-101 #2	W-BL-BN	7-0.012	DIRECT
92	R-103 (E-103)	R-134 (E-104)	W-BN	7-0.010	H3
93	R-157 (E-103)	X-112 #7	W-BN	7-0.010	DIRECT
94	X-112 #7	X-112 #8	JUMPER	#20 TIN	DIRECT
95	R-182B	C-140 B	W-R-G	7-0.010	N-P
96	X-112 #8	R-179 (E-102)	W-BN	7-0.010	M-N
97	R-131 (E-103)	X-106 #6	W-G	7-0.010	DIRECT
98	R-129 (E-103)	X-103 #4	W-BK-BN	7-0.010	DIRECT
99	R-185 (E-104)	R-130 (E-103)	W-R-G	7-0.010	H3
100	C-137 C	R-128 (E-103)	W-R-BK	7-0.010	D-F-G
101	R-128 (E-103)	X-103 #5	W-R	7-0.010	DIRECT
102	X-103 #5	R-121 (E-102)	W-R-BK	7-0.010	M
103	R-121 (E-102)	R-174 A	W-R-BK	7-0.010	DIRECT
104	R-141 (E-103)	R-140 A	W-BK-BN	7-0.010	DIRECT
105	R-144 C	R-143 (E-103)	W-BL	7-0.010	K-G
106	R-144 A	R-145 (E-103)	W-G-BN	7-0.010	K-G
107	X-108 #4	R-143 (E-103)	W-G-BN	7-0.010	DIRECT
108	C-123 B	R-149 (E-103)	W-G-BL	7-0.010	I

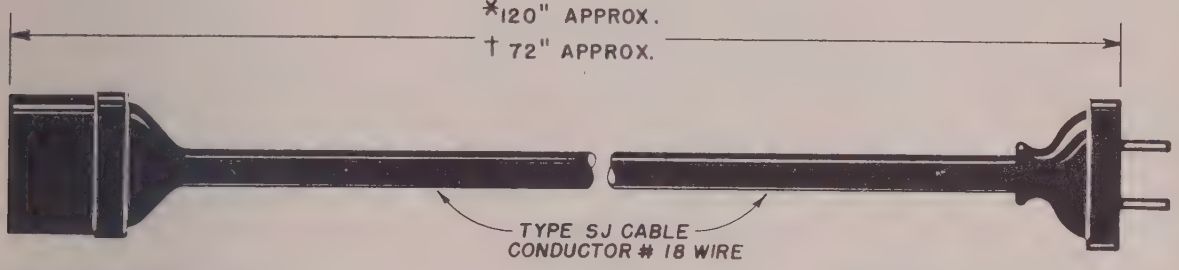
WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
109	R-156 (E-104)	R-155 (E-103)	W-O-G	7-0.010	H2-G-E
110	C-119A	R-156 (E-104)	W-O-G	7-0.010	G-H2
111	C-127 A	R-157 (E-103)	W-R-G	7-0.010	D-E-L
112	R-135 C	R-134 (E-104)	W-O-BL	7-0.010	B-H3
113	R-130 (E-104)	C-119 B	W-R	7-0.010	H3
114	X-107 #5	R-138 (E-104)	W-G	7-0.010	C-I-H3
115	X-107 #8	S-102	W-O-BK	7-0.010	B-C-I
116	S-102	GND #9	W	7-0.010	A-F-G
117	Not used	--	--	--	--
118	C-137 A	L-104 COM	W-O	7-0.010	DIRECT
119	Not used	--	--	--	--
120	L-106	X-111 #2	W-R-G	7-0.010	D-A
121	T-102 #14	S-101	W-O-BN	7-0.010	B
122	F-101 B	S-101	W-O-BL	7-0.010	DIRECT
123	T-102 #15	S-101	W-R-O	7-0.010	M
124	R-144 B	R-146 (E-104)	W-O-BK	7-0.010	K-F-A
125	C-119 C	R-146 (E-104)	W-O-BK	7-0.010	G
126	Not used	--	--	--	--
127	Not used	--	--	--	--
128	R-167 C	R-168 (E-102)	W-R-G	7-0.010	Q-P
129	C-115 C	R-170 (E-104)	W-R-BK	7-0.010	P-M-F
130	R-117 C	R-118 (E-102)	W-BL-BN	7-0.010	R
131	C-115 B	R-126 (E-102)	W-R-BL	7-0.010	P
132	J-101A	R-126 (E-102)	W-R-BL	7-0.010	Q-P
133	R-126 (E-102)	T-101 #2	W-R-BL	7-0.010	DIRECT
134	R-171 (E-104)	R-101 (E-102)	W-R-BK	7-0.010	P-G-F
135	R-101 (E-102)	T-101 #4	W-R-BK	7-0.010	DIRECT
136	R-106 (E-102)	X-102 #4	W-O-BK	7-0.010	DIRECT
137	R-107 (E-102)	L-103 #2	W-G-BL	7-0.010	DIRECT
138	X-103 #2	R-112 (E-102)	W-R	7-0.010	J
139	X-118 A	X-117 B	W-R	7-0.010	DIRECT
140	X-117 B	R-168 (E-102)	W-R	7-0.010	P
141	R-177 (E-102)	X-112 #4	W-G	7-0.010	DIRECT
142	R-177 (E-102)	X-112 #3	W-O-BK	7-0.010	DIRECT
143	X-112 #3	C-137 B	W-O-BK	7-0.010	M-E-D
144	C-137 B	L-104	W-O-BK	7-0.010	DIRECT
145	X-113 #4	R-178 (E-102)	W-R-G	7-0.010	M-N
146	R-178 (E-102)	R-182 B	W-R-G	7-0.010	DIRECT
147	C-140 A	R-109 (E-102)	W-BN	7-0.010	P
148	R-179 (E-102)	X-114 B	W-R-BK	7-0.010	DIRECT
149	X-114 B	X-113 #5	W-R-BK	7-0.010	M
150	X-113 #3	X-113 #5	JUMPER	#20 TIN	DIRECT
151	X-113 #6	R-181 (E-102)	W-O	7-0.010	M-N
152	R-181 (E-102)	R-182 A	W-BL	7-0.010	DIRECT
153	Not used	--	--	--	--
154	Z-2	R-167 B	W-G-BL	7-0.010	H7-A
155	R-167 A	R-166 (E-102)	W-BK-BN	7-0.010	Q-P
156	X-116 A	R-166 (E-102)	W-BK-BN	7-0.010	S-C
157	R-168 (E-102)	R-169 (E-104)	W-R	7-0.010	P-F-A
158	Not used	--	--	--	--
159	Not used	--	--	--	--
160	Not used	--	--	--	--
161	Not used	--	--	--	--

WIRE NO.	FROM	TO	WIRE COLOR	WIRE SIZE	CABLE ROUTE
162	X-107 #8	C-135 B	W-O-BK	7-0.010	B-C-H
163	R-127 A	GND #9	W	7-0.010	A
164	Not used	--	--	--	--
165	R-133 C	J-101 C	W	7-0.010	Q
166	L-101 #1	X-101 #8	W-BL	7-0.010	DIRECT
167	R-132 (E-103)	X-106 #5	W-G-BN	7-0.010	DIRECT
168	R-133 A	R-132 (E-103)	W-BL	7-0.010	DIRECT
169	R-133 B	R-133 A	JUMPER	#20 TIN	DIRECT
170	R-127 B	X-106 #4	W-BL-RN	7-0.010	E
171	X-106 #5	X-106 #3	JUMPER	#20 TIN	DIRECT
172	R-140 B	X-108 #1	W-G	7-0.010	DIRECT
173	X-101 #4	T-101 #3	W-G	7-0.010	DIRECT
174	X-102 #6	L-102 #2	JUMPER	#20 TIN	DIRECT
175	X-102 #3	L-103 #1	W-BL	7-0.010	DIRECT
176	X-103 #6	X-104 #6	W-BK-BL	7-0.010	DIRECT
177	X-109 #2	X-109 #5	JUMPER	#20 TIN	DIRECT
178	X-109 #5	C-128	W-BL-BK	7-0.010	L-K-O
179	X-113 #8	X-112 #5	W-O-BN	7-0.010	DIRECT
180	X-112 #5	R-176 (E-102)	W-G-BN	7-0.010	DIRECT
181	C-135 A	V-110 CAP	W-BL-PK	7-0.010	I-H-H6
182	R-163 A	C-134 B	W-R-G	7-0.010	Q-S-V
183	R-163 C	C-117 A	W-O-BL	7-0.010	Q-P-N-U
184	C-117 A	R-124 (E-106)	W-O-BL	7-0.010	DIRECT
185	C-117 B	R-125 (E-106)	W-O	7-0.010	DIRECT
186	C-117 B	R-165-B	W-O	7-0.010	U-N-P-Q
187	C-128	R-124 (E-106)	W-R-BL	7-0.010	O-T
188	R-123 (E-106)	R-124 (E-106)	JUMPER	#20 TIN	DIRECT
189	C-116 B	R-191 (E-102)	W-BK-BN	7-0.010	R
190	X-117 A	X-116 B	W-R	7-0.010	DIRECT
191	S-101	J-102	W-BN	7-0.010	H5-P
192	Not used	--	--	--	--
193	R-117 A	R-191 (E-102)	W-R-G	7-0.010	R
194	R-165 A	R-116 (E-102)	W-G-BK	7-0.010	Q-P
195	R-127C	J-101 B	W-R-G	7-0.010	A
196	C-125 B	R-153 B	W-O-BK	7-0.010	A
197	R-135 C	R-134 (E-104)	W-O-BL	7-0.010	A
198	Not used	--	--	--	--
199	R-135 A	R-135 B	JUMPER	#20 TIN	DIRECT
200	T-102 #5	X-111 #4	W-G-BN	7-0.010	F-A
201	T-102 #7	X-111 #6	W-O-G	7-0.010	F-A
202	R-117 B	L-105 (E-102)	W-O-BN	7-0.010	R-P
203	X-107 #4	R-140 C	W-BK-BN	7-0.010	C-I
204	X-106 #1	GND #6	JUMPER	#20 TIN	DIRECT
205	X-109 #6	C-121 B	W-R-O	7-0.010	DIRECT
206	C-121 A	R-125 (E-106)	W-R-O	7-0.010	M
207	I-101 B1	I-102 B1	W-BK	7-0.010	DIRECT
208	I-101 B2	I-102 B2	W-BK	7-0.010	DIRECT
209	F-101 B	J-102	W-BL-BK	7-0.010	DIRECT
210	X-113 #1	GND #7	W	7-0.010	DIRECT
211	X-112 #1	LUG MTG	JUMPER	#20 TIN	DIRECT
212	R.H. Door GND	C-137 COM	W	7-0.012	D
213	L.H. Door GND	X-118 GND	W	7-0.012	DIRECT
214	R-174 C	GND #5	W	7-0.012	DIRECT

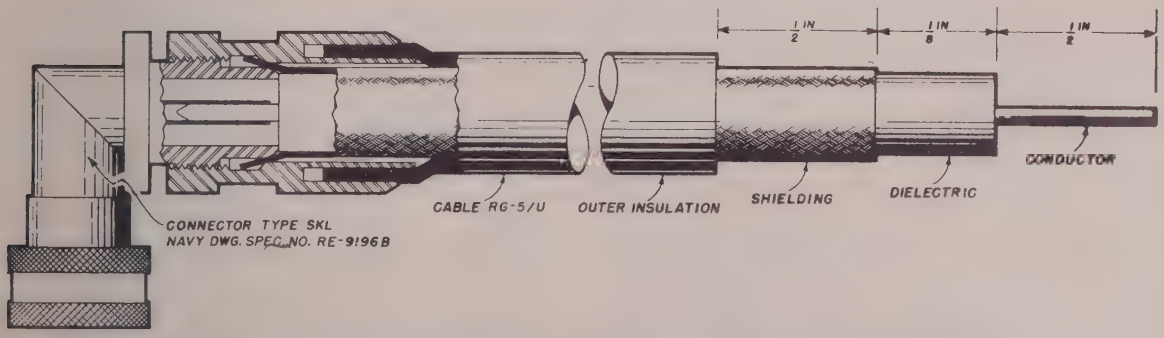
Figure 7-23. Wiring Legend (Serial Nos. 1001 to 1688) Fig. 7-23



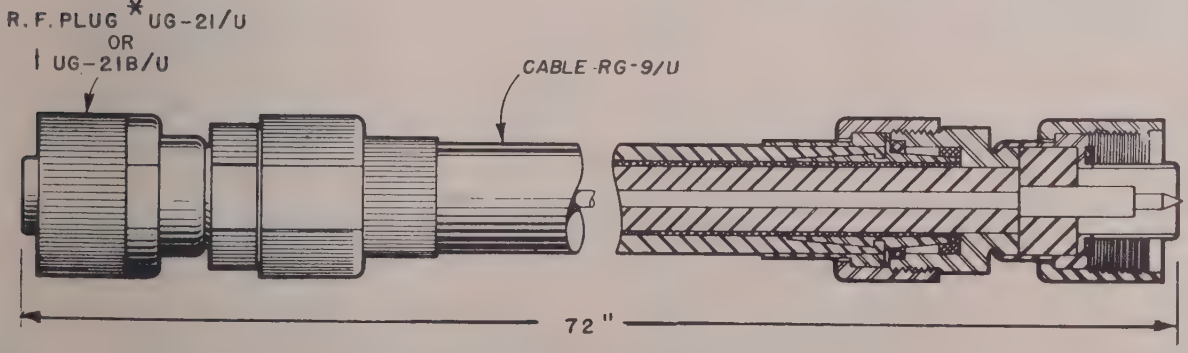
CORD CX-464/UP(4')



CORD *CX-337/U(10') OR †CX-337/U(6')



W-101 R-F CABLE CRYSTAL MIXER TO INPUT TRANSFORMER



CORD *CG-92/U(6') OR †CG-92A/U(6')

*SUPPLIED WITH SERIAL NUMBERS 1-817. † SUPPLIED WITH SERIAL NUMBERS 1001-1688

Figure 7-24. Cable Assemblies

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